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New Engine Lathe.

The illustration on this page represents an Engine Lathe of 28 in. swing, manufactured by David W. Pond, Worcester, Mass., from entirely new designs, and is the result of a careful study to produce a machine calculated to meet the demands of the present time, *i. e.*, a heavy, strong, accurate and durable tool with all modern improvements and conveniences, without superfluity of parts.

Great care has been taken to distribute the metal to strengthen the parts subject to strain, while conforming to the beauty and symmetry of the general design.

All moving parts have unsually long bearings, viz. the rest or carriage on the bed, also the tail block, the cross shoe on the rest, tool shoe on the swivel, top of tail block on its base in setting to turn tapers, length of tail spindle, also head spindle and its journals.

The diameters of the cone, gears, journal bearings and tail spindle are unusually large.

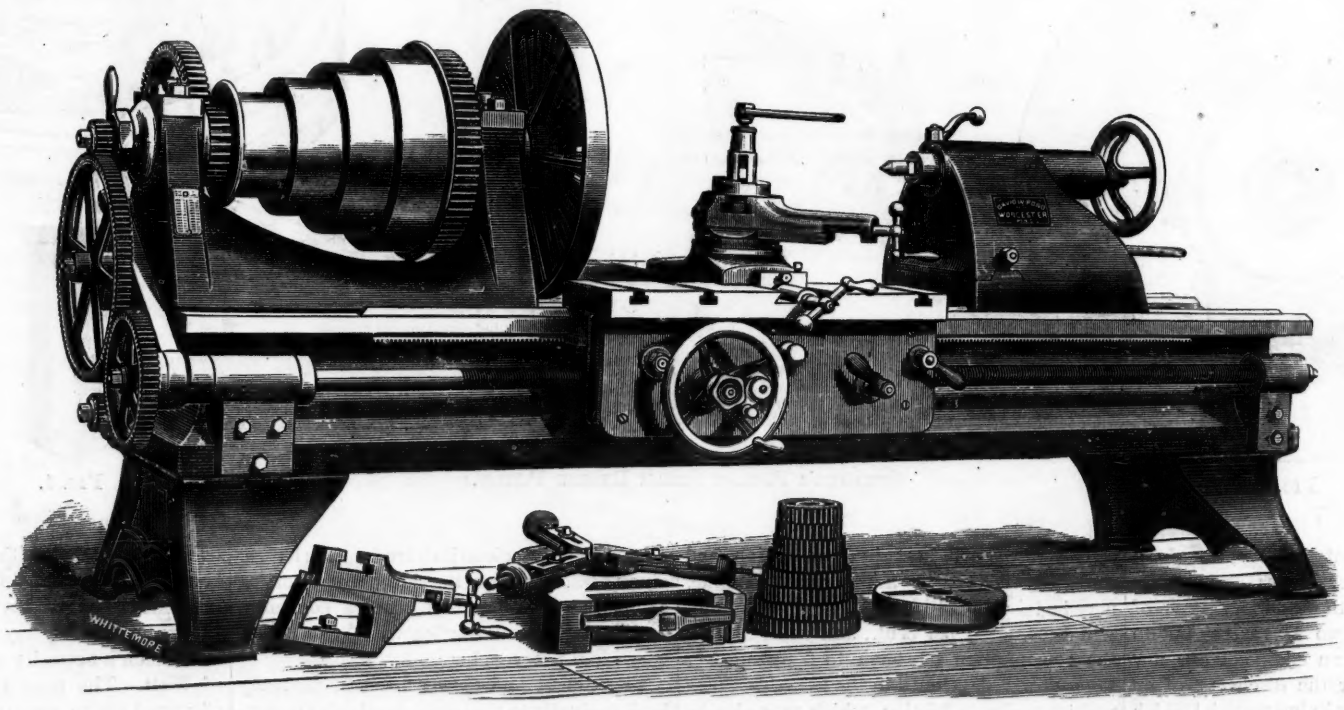
Feed motion is positive and very simple, tool can be made to travel forward and backward the length of the bed, or across the rest by a single movement of handles on the rest; hence always within reach of the workman when watching the cut, the cross feed has sufficient traverse to "Square off" entire swing of lathe with setting the tool but once. Tail block is fastened to bed by movement of one bolt only, and traverses nearly the entire width of bed in setting over for taper, and is operated by a single screw from the front side.

The feed gearing is connected to the rack on the bed, and is driven from a slot in the screw, arranged not to impair the accuracy of the thread for screw cutting, and is without worm or screw.

The feed motion is applied by a simple and positive friction. No studs are used. Every gear runs on a shaft having a bearing at each end. All small gears and shafts are made of steel or wrought iron, and all parts subject to bruising wear are case hardened.

A shafting attachment with three tools, each tool adjustable by a separate screw, operating the tool block that carries it, is arranged for turning and finishing shafting, leaving it round and smooth, with one operation only.

This lathe is manufactured by David W. Pond, Worcester, Mass., who will furnish all desired information to parties contemplating buying new or replacing old lathes with those of modern design and construction.



POND'S NEW STYLE ENGINE LATHE.

Philadelphia Engineers' Club.

The Engineers' Club of Philadelphia has recently been organized, and the membership limited to fifty. They meet twice a month. At the last meeting of the club eleven new members were elected. Mr. J. F. Robinson read a paper on "Steam Motors and Cars for Street Railways," in which he gave an interesting account of their manufacture, giving dimensions, weight, tractive power, &c. Steam cars, with seven feet wheel base, as at present built at the Baldwin Locomotive Works, have been successfully used on roads having curves as short as twenty-five feet radius, and grades as high as 369 feet to the mile. Mr. Robinson also stated that the comparative expense of operating roads by horse cars or steam cars has been proved by actual practice to be greatly in favor of the steam cars. Mr. Geo. Burnham, Jr., read a short paper on the "Stow Flexible Shafting." The largest sized shafting at present manufactured is 1¼ inches in diameter, with which a power of 69,000 lbs., or more than two-horse power can be transmitted. Mr. Chas. A. Ashburner read brief articles on the "South Street Bridge," "The Metric System" and "The Jetty Question." The papers were illustrated by models, photographs and working drawing.

On a new type of Steam Engine, theoretically capable of utilizing the full mechanical equivalent of Heat-Energy, and on some points in theory indicating its practicability.

Presented at the Nashville meeting of the American Association for the Advancement of Science, 1877.

(ABSTRACT.)

By Prof. Robert H. Thurston, of the Stevens Institute of Technology, Vice President.

Concluded.

It is also evident, at once, that this objection would be met, but in a less degree, with engines of the second of these two forms, and that the difficulty would be diminished by extending the range of working temperatures and pressures, and also that it would be lessened by any modification which should reduce the proportion of rejected heat. It follows, at once, that the direction in which we should look for improvement is that in which the well known expedients for increasing the economical value of the common type of engine may be adopted, with the addition of the single expedient here described of saving and returning to the reservoir all rejected heat, after its amount shall have been reduced to a minimum by those familiar methods.

The practical difficulties which stand in the way of the engineer who endeavors to realize the conditions described, are apparently insuperable. Yet this impossibility of realization is due, simply, to the existence of natural conditions which are comparable, in their influence, to the action of repellant central forces. We may conquer them in a certain degree by the exertion of any given amount of skill and intelligence; but, as we advance, the difficulty becomes more and more nearly insurmountable by finite power, and the perfect realization of the conditions and of the efficiency first idealized is only attainable by the exercise of an apparently infinite intelligence and power. Perhaps a better and more encouraging view would be given by the statement that we may expect to approximate to the realization of the efficiency of the ideal perfect engine more and more closely, as we advance in scientific knowledge and in constructive skill, without limit. It is therefore proper to inquire how far we are limited in this progress by conditions which are now common in the practice of steam engine construction. This we will presently do.

Complete utilization of all heat is not practicable with the heat engine of Type A under any known, or even conceivable, conditions in actual construction.*

Type B, in which all unutilized heat is restored to the reservoir, comprehends engines of two very different kinds. These are:

1. Heat engines in which the rejected heat is transferred from the mass of working substance discharged from the working cylinder at the end of the stroke of the piston, to a mass of metal or other heat-absorbing material, and from the latter again transferred to another and a new charge of working fluid, which is about entering the reservoir to take up a new stock of heat energy.

2. Heat engines in which, as in the ideal engines already described, the rejected working fluid itself, with its contained unutilized heat, is all returned to the reservoir.

* The two kinds of fluid, working in engines of the Class A, are seen to give two characteristic products of the two known processes of abstraction of heat from fluids: 1. Forcibly compress the fluid, removing the heat of compression as rapidly as it is generated; the product is, after all heat has been removed, a mass of maximum density, probably solid in all cases, and at the absolute zero of temperature. 2. Abstract the heat contained originally in the mass, by causing its expansion against a resistance; the product is a diffused mass, without tension, of minimum possible density, and at the absolute zero of temperature.

The direction in which further improvement must take place in the standard type of engine, is plainly that which shall most efficiently check losses by internal condensation and re-evaporation by the transfer of heat to and from the metal of the steam cylinder. The condensation of steam doing work is evidently not a disadvantage, but, on the contrary, a decided advantage.

To secure this vitally important economy, it is advisable to seek some practicable method of lining the cylinder with a non-conducting material.† The loss will also be reduced by increasing the speed of rotation and velocity of piston. Where no effectual means can be found of preventing contact of the steam with a good absorbent and conductor of heat, it will be found best to sacrifice some of the efficiency due to the change of state of the vapor, by superheating it and sending it into the cylinder at a temperature considerably exceeding that of saturation. With low steam and slowly moving pistons, it is better to pursue the latter course than to attempt to increase the efficiency of the engine by greater expansion.

Increasing steam pressure and expanding to a greater extent will give theoretically slightly increased economy. Repeating the calculation made above, using as constants the temperature, volumes and pressures of steam entering the cylinder at 250 pounds, and expanding down to the same point, it will be found that the gain in efficiency is but a few per cent. It is not in that direction, therefore, that we are to look for important improvement in the use of the ordinary type of engine. There seems no alternative but to attempt to alter it into an engine of our new Type B, and look for the discovery of an efficient non-conducting lining material which shall enable us to save the, probably, thirty per cent. of heat supplied which is transferred to the condenser by internal condensation and re-evaporation.

The question whether such an engine as that which has here been described as type B can be made practically successful, can only be answered after careful and intelligent experimental investigation. The advantages promised, by the results of theoretical investigation, will be greatly modified by conditions unavoidably introduced in the construction and operation of the machine. Some of these conditions may be anticipated, and their effect upon the efficiency and upon the success of the engine in other respects may be indicated in advance. It is even possible that a rough approximation may be made in estimating its real practical value.

The essential requisites of a successful type of engine are: safety; economy; durability; simplicity; compactness, and a moderate first cost.

Safety may always be secured by intelligent design, good material and workmanship, and skillful management. The new type is not especially liable to objection on the score of danger, except so far as it may prove essential to its success to work at exceptionally high pressures; but as pressures of 1000 and 2000 pounds were controlled without accident, forty years ago, by Perkins and by Albans, it is not to be anticipated that danger will necessarily be incurred at pressures far exceeding those in general use to-day, yet far within the limit already attained. The durability of the engine will also be determined by the same conditions as its safety, and is to be assured in the same manner. The actual economy to be secured by its adoption is largely determined by the size which it may be found necessary to give it; for its losses will be almost wholly due to friction. In simplicity, it is not likely to compete with the common engine, since it must be fitted with some apparatus for compressing the steam to be returned to the boiler. It is not improbable, however, that the new type may be yet given a form in which it may compete nearly as successfully, in this respect, with the ordinary engine as has the compound type of the latter with the older forms.

Assuming an engine of the proposed type to have an estimated efficiency of fluid of 50 per cent., it must be made, at the same piston speed, twice the size of the engine of the common form. To allow for increased frictional and other losses, an addition in enlargement of probably 25 per cent. must be calculated upon. The theoretical cost of the horse-power will be about 5 pounds of steam per hour.

The losses of heat by conduction and radiation, which, in the common engine, may be taken as 10 per cent. as a maximum, will become 20 per cent., and will bring up the consumption of steam to 6 pounds per horse-power developed in the cylinder. The resistance due to friction, which may also be taken at 10 per cent., will be doubled also, and this will raise the expenditure of steam to above 7 pounds. We may take, as the probable consumption of heat in such an engine, per hour and per horse-power, very nearly 8000 British thermal units. With good boilers, this will call for the combustion of about three-quarters, or four-fifths, of a pound of good fuel—about one-third the amount demanded by the very best engines ever built for transatlantic steamers, and one-quarter as much as is usually consumed with very large marine engines of the now popular compound type. But the advantage to be secured by the adoption of this type becomes greater with higher pressures, and will therefore be likely to appear greater and greater continually. With what would now be thought exceedingly high steam, and with vastly increased piston speeds, such as will almost certainly be adopted in the future, the new type will appear a very much more promising plan than it now does.

The now standard engine drives a steamship across the Atlantic with a consumption of 1000 tons of coal; the new engine should do the same work on 250 tons. It should occupy but little more available space in the ship, but would weigh twice as much unless the piston speed were correspondingly increased. The greater weight of engine would be vastly more than counterbalanced, however, by the reduction of space and weight devoted to boilers and coal-bunkers, to one-third or one-fourth their present capacity. If this type of engine should prove to be available with steam pressures that are soon to be found readily controllable, it is certain that it will be even more advantageous for marine purposes than for use on land, where these reductions of space and weight are of less importance. Even its application to locomotives would not be thought impossible.

Several engines of this type have been planned by the writer, in all of which the rejected heat is returned to the boiler.‡

Any expert mechanical engineer will readily devise many methods by which the standard forms of steam engine may be modified and converted either into illustrations of this Type B, or into engines of Class 2, in which the rejected heat is very nearly all restored to the boiler. When this possible "engine of the future" is likely to be introduced, if at all, can be scarcely even conjectured. It seems evident that its success is to be secured, if its introduction is attempted, by the adoption of high steam pressures of great piston speeds, by care and skill in design, by the use of exceptionally excellent materials of construction, and by great perfection of workmanship and intelligence in its management. There seems no tangible obstacle to its introduction; but engineers who have seen the slow progress of the compound engine and of surface condensation in marine construction will anticipate no very rapid progress here.

Experiment and experience will probably lead gradually to the general and safe employment of greatly increased steam pressures and very greatly increased piston speeds, and will ultimately reveal and remove all those difficulties which must invariably be expected to be met here, as in all other attempts to effect radical changes, however important they may be. We are continually learning that the use of steam as a medium for transformation of heat into mechanical energy is more advantageous than it had been supposed.

The corrected estimates of the efficiency of the steam engine, given above, show it to be capable of far more perfect utilization than generally accepted authorities had supposed possible. It is not improbable that even these estimates give a very inadequate idea of the true efficiency of the perfect steam engine. We know almost nothing of the physical properties of steam which are mostly concerned in its utilization in heat engines at the high pressures which we know are attainable; and it is impossible to say that the modifications of specific heat and of pressures at such high temperatures may not be such that it may prove a vastly more efficient working substance for the heat engine, at such temperatures and pressures, than we are led to consider it from our knowledge of its properties at the now usual working pressures.

† This plan was adopted by Smeaton, in constructing Newcomen engines a century ago. Smeaton used wood on his pistons. Watt tried wood as a material for steam cylinder linings. That material is too perishable at temperatures now common, and no metal has yet been substituted, or even discovered, which answers the same purpose.

‡ The idea first suggested itself to the mind of the writer in 1858-9, when at Brown University, and while designing a peculiar form of "drop cut-off engine," which was designed to work with exceptional economy. The plans then conceived have gradually assumed a different shape, but still embody the essential principles here outlined.

Sprague's Patent Steam Engine Piston.

The Piston is one of the most important adjuncts of the steam engine; all the other parts are subsidiary to it. They may be altered, modified, or in some cases dispensed with, but whatever change or modification they may undergo, the piston must still be retained, as in it lies the vital energy of the steam engine, No part of the steam engine since its advent, has proved a greater source of annoyance to the engineer, or anxiety and waste to the steam user; to this may be attributed the efforts on the part of engineers and inventors to perfect a device that would meet all the requirements of a good piston. The patent offices of this and all other countries are crowded with devices which have been from time to time claimed to be improvements on all previous inventions, and yet at the present day a good steam piston is as much a necessity as it was in the days of Watt. The most essential requirements of a good piston are strength, lightness, simplicity, durability, and convenient arrangement for easy and accurate adjustment.

The piston illustrated in the annexed cuts is claimed to embrace all the foregoing features in an eminent degree.

Fig. 1 shows an end view of the piston, with the follower plate removed, as well as the junk ring, springs, adjusting screws, blocks, &c.

This piston can be applied to cylinders of any size and construction. To expand the packing all that is necessary is to remove a plug in the cylinder head opposite the center of either of the wheels, and insert the box wrench. The power applied to one is applied to all.

The wedge-shaped blocks, shown in section of fig. 3, having corresponding bevel in vertical section, the blocks when forced toward the follower by means of screws, as shown, increase the diameter of the sections upon which the springs are mounted, and forces the packing equally all around, the strain of one section being transmitted to the next through the blocks having oblong holes for screws, and nuts to work free in, thereby uniting the springs all in one.

Fig. 2 represents the follower. The center

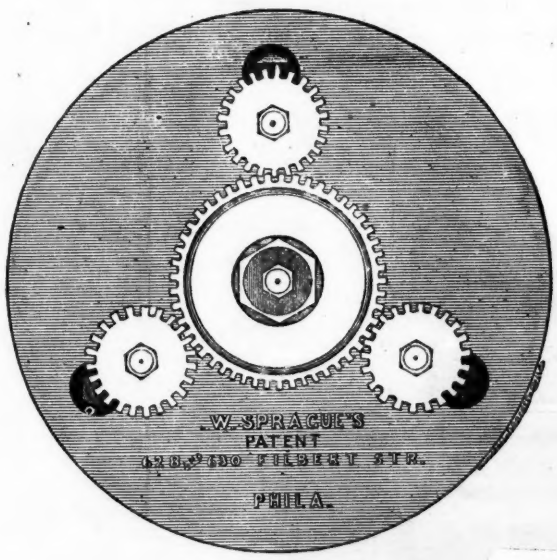


FIG. 2.

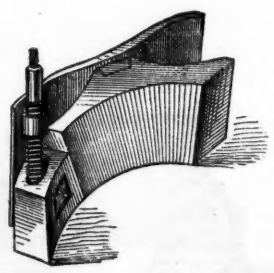


FIG. 3.

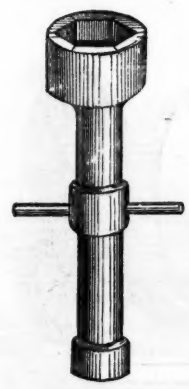


FIG. 4.

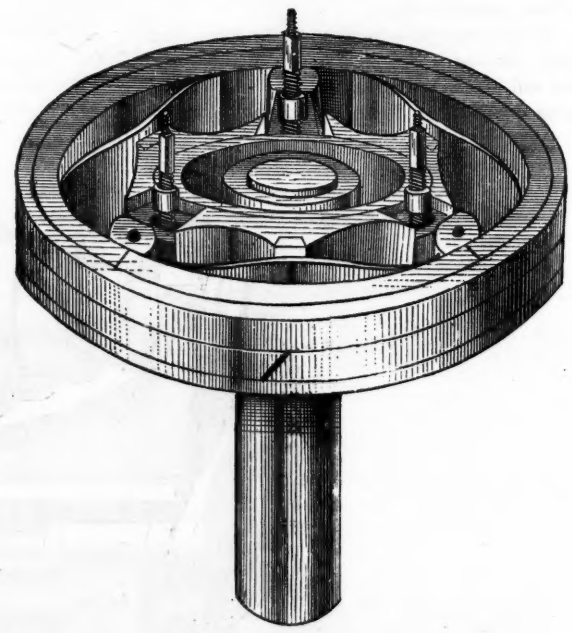


FIG. 1.

SPRAGUE'S PATENT STEAM ENGINE PISTON.

spur wheel is an idler, which plays free upon a stud fast in center of follower; said wheel having a hub to receive large end of box wrench, Fig. 4. Small end fits a nut on center stud for locking said wheel and insuring it remaining in position until it is necessary to remove it again. This piston is guaranteed to do the same work with ten per cent. less boiler pressure than any piston now in use.

Among the most valuable features claimed for this piston are the following: that it requires no extra skill to adjust it to its position in the cylinder; that it cannot get out of a central position by long use, hard treatment, or from any other cause; that it can be adjusted when the cylinder and piston are heated up to the working temperature (thereby obviating the difficulty arising from the piston being too tight or too slack), that it can be adjusted without removing either the follower plate or the cylinder head, and that it can be manufactured and sold cheaper than any other piston now in use.

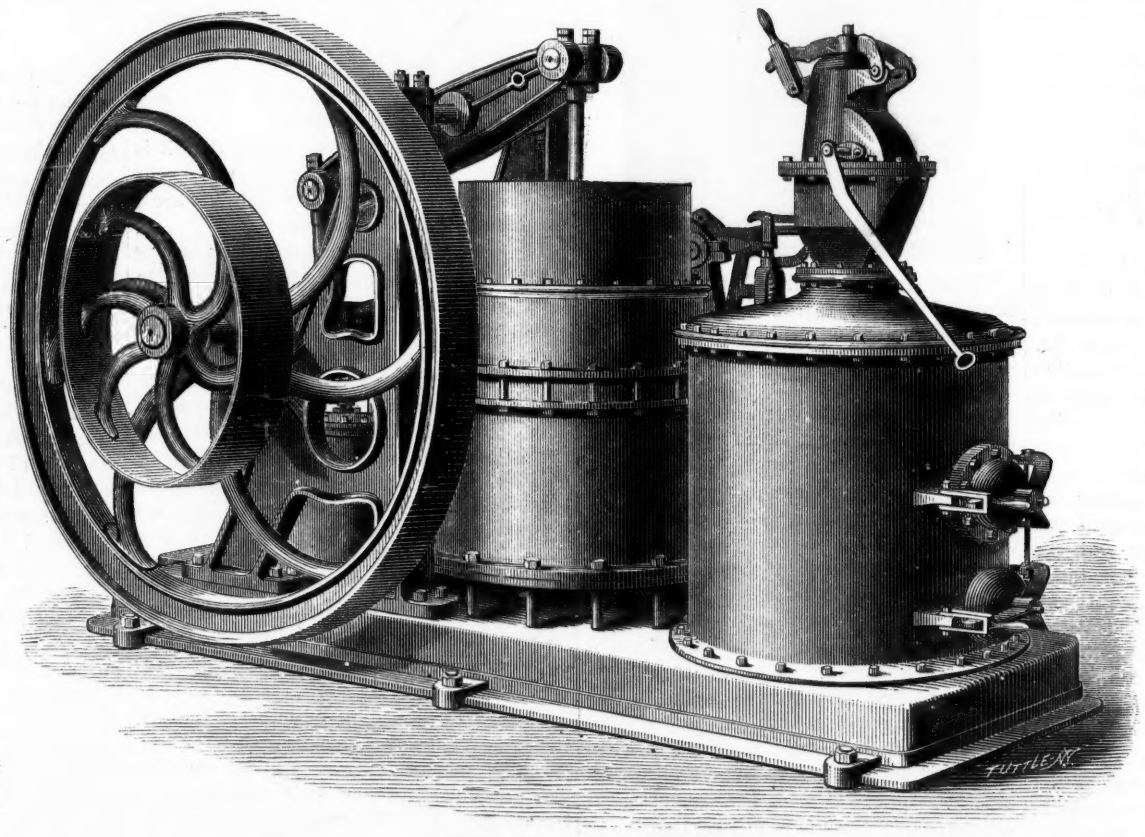
It is manufactured by the patentee, William Sprague, 635 Filbert Street, Philadelphia, who also disposes of shop or territorial rights to use it.

Brown's Caloric Engine.

While the steam engine has been well developed for many years past, and its powers and capabilities well known, the hot air engine may be said to be in its infancy. Since the construction of the original Ericsson Caloric Engine several motors of its class have been brought out with much promise, only to be rejected after a few months' practical use, with but one or two exceptions. For small power some of them have been used with fair success. The accompanying engraving shows a hot air engine of an advanced and improved type, the idea being to produce one of a heavier grade than the light ones formerly in use.

The engine may be made to work at variable pressures, independent of the pressure due to the expansion of air in the heater.

This desirable result, needed to perfect the working of a caloric engine, has been accomplished by the combination of a cut-off mechanism with the inlet and exhaust valves, and the use of double eccentrics, whereby the engine may work with full exhaust and cut-off at any part of the stroke; and by which an increase of pressure is secured in the fire-box greater than is due to the initial expansion of the air.



BROWN'S CALORIC ENGINE.

This engine has been patented in this country and the principal European countries, and is claimed to possess superior merits, which we briefly state:

The starting of the largest sized engine is easily effected. The heater is completely separate from the working cylinder, hence it may easily be relined with fire-brick whenever necessary. The connection between the piston and crank-rod is self-oiling, and the packings are so arranged as not to be destroyed by heat.

Fuel is supplied without stopping the engine, and the movement of the engine is still and smooth, doing away with all the jar and booming noise heretofore experienced.

It is claimed to effect a saving in fuel and in insurance. The engine can be set in motion in about ten minutes from time of starting the fire. It is well built, the working parts all being of steel, so as to be strong enough to stand the same usage as a steam engine.

The engine is the invention of Felix Brown, and is manufactured by A. & F. Brown, 57 Lewis Street, New York.

Speech is silvern, silence is golden.

Steel Plates for Boiler-Making and Ship-Building.

It is now about twenty-one years since "puddled steel" plates came into use for boiler shells and ship-building. The desire to avail themselves of the reduction in thickness of plates, which the 50 to 100 per cent. greater tensile strength of the new material appeared to allow, led designers to try it in a few cases where the weights of locomotives and small ships, in the construction of which steel was employed, were limited by the strength of rail and draught of water available. A few marine and stationary boilers were also made of steel. Some of the boilers and ships answering well, led to a continuance of the use of this steel, whilst some boilers proved unsatisfactory and were replaced by boilers of iron plates. A few of the ships made of puddled steel failed in consequence of faulty design, the designers having wrongly taken it for granted that the section to resist compression could be reduced in the same proportion as that to resist tension. The general failure of the new material was in some measure due to the want of knowledge of its properties and want of skill in working it. In some cases, however, the steel proved to be so laminated and liable to be injured by the corrosive action of the water, when used both for boilers and ships, that its trial turned out a costly and unsatisfactory experiment. The advantage of greater tenacity was not sufficient to outweigh the disadvantage of increased brittleness, as long as the material inherited all the short comings of wrought-iron plates.

It was not until about fifteen years ago, when plates of Bessemer steel were offered to the makers in quantities, that the use of steel for boiler-making can be said to have become fairly established. Even up to the present day its use to any considerable extent for stationary boilers has been confined, with few and unimportant exceptions, to some half dozen boiler works in the Manchester district, but these are of the very highest standing. Only two of these, however, have used steel extensively for shells, the rest having contented themselves by using it chiefly for the furnace tubes. Bessemer steel plates have been used for boilers of various kinds by upwards of fifty other makers in different parts of the kingdom, but as a rule against the advice of these makers, and (shall we say consequently?) often with unsatisfactory results.

For locomotive boiler shells, Bessemer steel plates have been used almost solely in this country by the London and North-Western Railway Company, who have used them over twelve years, and, it is said, with entire satisfaction. The anomaly of this railway company using nothing but steel plates is of easy explanation. The company is not only singular in manufacturing the material for its permanent way and rolling stock but it is equally fortunate in having a locomotive superintendent and works manager, who is quite as much at home in manufacturing steel as in building locomotives, and it may be safely affirmed that no one else has had as much experience in the making and using of Bessemer steel plates. The power and facility here afforded of choosing the most suitable standard of material for rails, axles, tires, and boiler plates from the different casts, may possibly account for the bold and successful lead so long held by the North-Western Railway Company in adopting the material that others may admire, but hold back from using.

Some of our locomotive builders have made boiler shells of steel for abroad, where the prejudice against its use could not have the same weight as at home. It must, however, be admitted that in more than one instance the user has had cause to regret he had not taken the maker's advice and used iron instead. Plates of Bessemer and of Siemens-Martin steel have been also used in this country for locomotive fireboxes, in some cases with success, but in the majority of cases the plates were found to fracture at their edges, near the flanges, or from the stay holes, and their use has been in consequence abandoned. In the United States, however, they have been used with considerable success.

For marine boilers steel plates have been used only to a very limited extent. Of forty of the best known firms of marine engine builders, including those who make for the Admiralty, up to a very recent date only about half a dozen had used steel plates, and half of these would not have used them if they had their own way.

At the present day there are probably about 2500 boilers with steel shells working in the United Kingdom, and perhaps 7000 boilers with steel furnaces and fireboxes. Of the extent to which steel has been used as a boiler material on the Continent it is difficult to obtain anything like accurate information, but it has been used to a considerable extent, while in the United States it has, as we have said, been largely employed by some locomotive builders.

For shipbuilding steel plates have made their way even more slowly than for boiler making. This can easily be accounted for by the fact that the difference in the prices of boiler plates in iron and steel is not very great, in fact, the price is sometimes in favor of steel, whilst there is a very material difference between the prices of iron and steel plates in shipbuilding, except in the case of vessels built for the Admiralty. As the Admiralty get money to build ships, whilst builders for private firms build ships to get money, it is not surprising that the former can afford to pay twice as much for their iron plates as the latter. Fortunately it happens that, in paying this large price, the Admiralty have at the same time seen that they were getting their money's worth, and by so doing have assisted directly and indirectly in keeping up the standard of quality for iron plates in this country. Nor is it surprising that the first attempt on a large scale to use stee for shipbuilding has been made by the Admiralty, who, however, waited till the French dockyards and engineers led the way in 1873, as they had also done twelve years previously with the introduction of armor-clads. The use of steel for the hulls and boilers of steam launches during the last six years has been very successful.

Another reason why steel has been so little used in shipbuilding is that until the close of last year the rules of Lloyd's Registry for iron ships did not recognize the greater tenacity of steel. We shall shortly revert to the report accompanying the announcement that this restriction has been removed, which appeared lately in *Engineering*.

The conclusion to be gathered from this short review of the employment of steel plates for boiler making may be summed up as follows: That of some eighty boiler-makers who have fairly tried steel plates only some eight or nine can be said to have persevered with its use and used it extensively; that where the use of steel plates has been persevered in against the advice and feeling of the boiler-maker, the result has generally been unsatisfactory; that it may be taken for granted that the prejudice on the part of the boiler-makers against the use of steel is, as a rule, inversely proportionate to the extent of their acquaintance with it. It would appear that those makers who have not been alive to the difference required in the working and treating of iron and steel, or have gone timidly to work, and let the workmen find out for themselves the best way to treat steel, have usually had trouble, and have been only too glad to receive a confirmation of their adverse opinion. On the other hand, those makers who have appreciated the superior qualities of steel over iron, and have been strongly possessed by the conviction that steel is in nearly every respect the better material and who have in consequence taken to its use with a will, given personal attention and got their men taught how to heat steel plates properly, who have in fact made a specialty of making steel boilers, have succeeded admirably.

It must, however, be admitted that some makers have not been so fortunate as others, and one maker at least, who has long used steel plates largely for flues, dreads using them for shells. It must be further conceded that a great many steel plates for boiler-making and shipbuilding have fractured before they left the plater's and riveter's hands, and some steel plates in boiler shells have fractured on testing them with hydraulic pressure, and several steel plates have in consequence been replaced by shells of iron. Cases of this kind have occurred since the recognized standard of strength for steel plates was reduced to 32 tons, and there is no doubt that an opinion exists amongst many engineers at the present day that steel plates are still untrustworthy. We purpose in a future number, to examine the causes that have led to this widely-spread and deeply-rooted prejudice with a view to determine whether the causes still exist to the extent they did some years ago.—*London Engineering.*

The Canton Bridge Co., of Canton, Ohio, was recently incorporated with a capital of $150,000.

The Condensation of Steam by the "Injector Condenser."

BY HENRY W. BULKLEY, ENGINEER,
149 BROADWAY, NEW YORK.

In a previous article was explained the methods of condensation in common use on marine as well as on some land engines, and in which an air-pump is required to form and maintain the vacuum.

Whatever virtue remains in the exhaust steam at the end of the stroke of the piston, is here expended in agitating the contents of the condenser without producing useful effect, and thus making it necessary to provide some other means for continuously discharging the contents thereof against the atmospheric resistance without.

The Injector Condenser, so called because its action is somewhat similar to that of the well-known "Gifford" boiler injector, dispenses with the *air-pump*, and saves three-fourths of the power required to work the same, besides affording, at a reduced cost, a simple and durable apparatus, and one easy to operate even by unskilled labor.

In this invention, advantage is taken of the fact, that steam of atmospheric pressure will rush into a vacuum at the rate of 1,600 feet per second, and the water of condensation is so presented thereto that it shall receive and absorb this force with useful results.

The condenser is formed of *two conoidal* nozzles joined by a straight neck and swelled at the upper end for the junction of the water nozzle. Within is the exhaust steam nozzle which forms, with the condenser, a *narrow annular space* for the entrance of the condensing water. The sides of the condenser (which are paraboloidal curves) are smoothly finished as is the contracted neck below, to diminish the resistance of the water.

When the exhaust steam from the engine meets the thin film of water which enters by the annular space it is instantly condensed, imparting a portion of its velocity thereto. As the water passes down, the contracting outline of the condenser gradually brings it to a *solid jet* in the neck below, through which it rushes at a velocity of about 16 feet per second, experience fixing this as the most favorable speed. The air which has entered the condenser with the water, or through leaky joints and stuffing boxes, together with the uncondensed vapor, is thus *drawn down* into a contracting, hollow cone of water, until finally expelled through the neck. This latter being straight for a distance is virtually the *air-pump* having a solid piston of water moving at a high speed; thus is the steam condensed and the vacuum found by a single process and with greater certainty than in any other way. The air and vapor, having passed the contracted neck, enter the tapering nozzle below, and expanding therein, are prevented from returning to the condenser above.

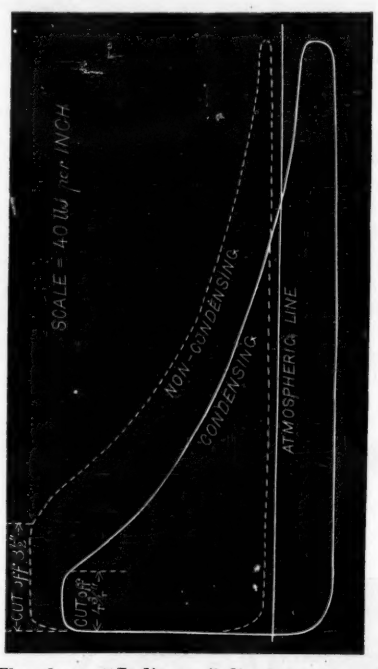
To remove, as far as possible, the atmospheric resistance from the condenser, there is attached to the lower end of same a *vertical* discharge pipe about thirty feet long, so that by *no possibility* can the water be lifted over into the cylinder of the engine, as may occur in every other form of condenser in use.

In starting the engine the first action of the exhaust steam is to expel the air from the exhaust pipes and condenser, when a jet of water from a tank, water works, or pump will form the vacuum, and the water is then elevated about twenty-five feet by atmospheric pressure, an allowance of about four feet being made for friction in the annular water opening, pipes and elbows. Thus, by a head of ten feet from a natural fall, public water works, or from a water pump worked by the engine, a steady vacuum of from twenty-seven to twenty-nine inches may be obtained and perpetuated. The water supply is thus self-regulating, requiring no opening and shutting of injection cock, and no danger is incurred of flooding the engine cylinder through carelessness.

Another advantage lies in the vertical exhaust pipe, which is always ready for "high pressure," if required, by the removal of a bonnet on top of same, or by the automatic opening of a self-acting valve arranged thereon.

The discharge water may pass off at a temperature of 110 to 120 degrees, when the vacuum is equal to twenty-six inches of mercury, and the amount of same is *less* than with ordinary condensers, owing to the cooling action of the vertical exhaust pipe and condenser which are usually exposed, in part, to the atmosphere.

No foundations are required for this condenser as it may be set up wherever convenient, often in the fire room, or outside the building. Any water pump, of suitable capacity, (whether fire or tank,) will supply the condensing water and can perform other duty at the same time, if required. Where a steam pump is employed it may exhaust into the condenser, and will use no steam above the atmospheric pressure.



The above "Indicator" diagrams are exact copies of those taken from an automatic cut-off engine, in which, (with the same power), the difference in the point of cut-off with and without the condenser is seen. The power gained by the vacuum was nearly equal to 100 horse, and the saving in steam about forty per cent., while the water pump, by actual test, used less than *two horse power*.

The following figures show the relative power required to work the ordinary *air-pump* and the water pump of this condenser:

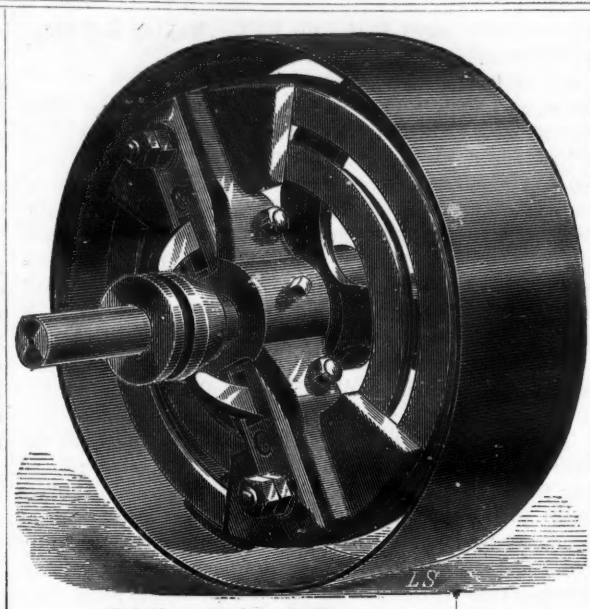
The former usually fills about *one-fifth* with the water of condensation, the remaining space being occupied by air and uncondensed vapor, while its piston is resisted by an average pressure (at twenty-seven inches of vacuum,) of about *eight* pounds per square inch. The water pump of the "Injector" Condenser, with about *one-fifth* of the air-pump capacity, works against a pressure of about *five* pounds, (or ten feet head,) as explained.

The friction of the air-pump and its connections are plainly the greater of the two, its piston being larger and having a greater resistance; but with friction aside, the relative power required by the two pumps is as 8 *to* 1, showing a large balance in favor of the Injector Condenser. It has also the merit of ability to work at a large distance from the water supply, as the same is drawn by an independent pump which cannot become heated by the exhaust steam in starting before the water is obtained. This heating up is often a serious trouble with the air-pump condenser, and causes delays by loss of the vacuum.

The Injector Condenser will also form a high vacuum on vacuum pans and oil stills, dispensing with the air-pump now used, and it will remove noxious vapors and gases from stills, kettles, etc., working with hot water, where necessary, a high vacuum not being required in such cases.

It is thus seen that by a radical departure from the old methods of condensation some advantages have been secured in economy, simplicity and safety, with less complication of apparatus than before.

Putty costs more per pound than cast iron. This ought to satisfy a purchaser of a machine who finds the former where he expects to find the latter



Friction Clutch Pulley.

The above cut shows one of Bean's Patent Friction Pulleys, for very heavy work. By a combination of levers in this mechanism, the power can be weighed to such a nicety as to relieve all strain and back lash, occasioned by a number of Engines or Engines and Water Wheels running together, when our clutch is employed to connect them.

It cluthes all machinery moved by wheels in a perfect manner, with ease; is durable; runs without noise; no end thrust on Journals; no loss of power.

In Rolling Mills, particularly Brass and Rubber Mills, it is very efficient.

Experience in its use has shown that it is impossible for damage or breakage to occur to gearing or machinery on which it is used, if the directions are followed.

In Saw Mills, for hoisting logs—along Docks—in Mines—in Warehouses, and in fact for all heavy hoisting, it is finding universal favor.

Its construction is very simple. The Pulley or Clutch runs loose on shaft, so that power can be transmitted at any desired speed and amount, allowing the engine or shaft to run at its full capacity at all times, if desired. The strong massive arms on one side, and bolts on the other side of the Pulley ring, are brought in such positive contact with ring by a few pounds of pressure on Clutch lever, as to make the Pulley as effective as if keyed to the shaft. This is the only Pulley in the market on which there is no Lubricator used on friction surfaces, and on which dependence can be placed for heavy work.

Clutch Couplings for stopping of lines of shafting without stopping or slacking the speed of motive power, also for starting heavy machinery of any kind, that needs to be brought up to the proper speed gradual, such as Force Pumps, Picker Rooms in Mills, Print Works, Bleacheries, Paper Mills, Circular Saw Mills, this clutch has not its equal. No shipper is furnished without they are ordered as extra; all Pulleys or Clutches that run at unusual high speed, should be bushed with bronze metal.

They are for sale by The George Place Machinery Agency 121 Chambers, and 103 Reade St., N. Y.

Emery Wheels.

BY JOHN F. WOOD.

There is no tool of more general use in a machine shop or manufactory than a solid emery wheel, and there is no tool so little understood, or we will say so greatly misunderstood.

If we may judge by the manner in which we often find them mounted and used in shops the popular idea would seem to be; not only among ordinary, but good mechanics, that anything would do to run an emery wheel or which would revolve it at a very high rate of speed, and that the wheel should stand any amount of abuse; and to this fact is probably due fully nine-tenths of all the accidents by bursting and trouble generally with wheels.

While it may be true that an emery wheel thus mounted and abused may be very useful, pay well, and do a great variety of work in a shop, it is also true that if it were mounted in a proper manner in a suitable machine, and used with the ordinary care and attention that would be given to any other tool, it would be more useful, pay much better, and do a greater variety of work; in fact, would become the most useful as well as indispensable tool.

The first requisite to the proper running of an emery wheel is the machine upon which it is mounted. This should be proportioned in weight and stability to the size of the emery wheel, and also to the weight of the articles to be ground; always remembering that if the machine is too slight, perfect work will be impossible, whereas there will be no disadvantage in having the machine stronger or heavier than is necessary. The mandrel should be large and well fitted to the bearings, which should be long and have no end play, else the corners will be knocked off the emery wheels. It should have a fixed flange and a loose flange, between which the emery wheels should be secured, and a nut and screw by means of which they can be closed to the wheel. Care must be taken that the faces of the flanges are at a right angle to the mandrel; a little deviation will tend to break the emery wheel when the flanges are brought together. We have seen many wheels broken in this manner or cracked, to fly in pieces as soon as started, the operator being at a loss to account for the breakage in any other manner than that the emery wheel was poor. A packing of rubber-cloth or thick paper should be inserted between the faces of the flanges and the wheel; this will tend to overcome any slight imperfection in the accuracy of the flanges, insure a better fit, and secure the wheel more firmly and with less pressure by the nut.

When the emery wheel is secured between the flanges it should run perfectly true, and it should also be in perfect balance. If any emery wheel when mounted perfectly true is found to be out of balance, it should be immediately condemned or not used until is has been properly balanced, although before condemning the wheel it would be well to see that the trouble is not in the mandrel itself. The hole in the emery wheel should never be a tight fit on the mandrel, because the latter may become heated and the emery wheel will be burst or wedged open by the expansion. It is better to have the hole in the emery wheel much larger than the mandrel and a bushing inserted to reduce it to the proper size. This bushing may be of any of the different compositions of soft metal like Babbitt, to be melted and poured in or turned true from the harder metals, or from wood, and slipped in. The practice of securing the emery wheel to the mandrel by means of a key cannot be too srrongly condemned.

To be continued.

There is need of positive reform in settling up the affairs of bankrupts. In most kinds of trade, when parties fail they go out of business, or at least start up entirely new, but many manufacturers of machinery have failed, compromised with their creditors for a fraction of what was owed them, and taken a fresh start with no debts to bother. Settlements of this kind usually enable bankrupts to outreach and undersell their competitors who pay 100 cents on the dollar. It is is difficult for those whc pay in full to do a profitable business against those who pay but twenty or thirty per cent. on their obligations.

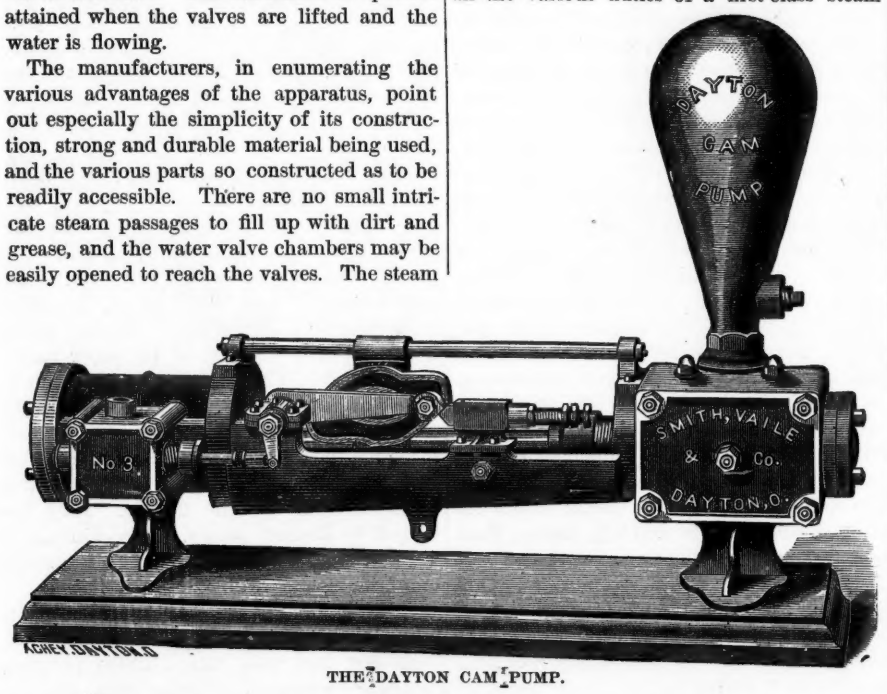
Locomotive and stationary boiler works are found to be unusually crowded with work just now, and the large shops are running to their fullest capacity. Two large engines under way at the extensive works of Ainslie, Cochrane & Co. are particularly noteworthy, owing to their extraordinary size, power, and beauty of finish. One of them is a 31-inch cylinder by 9-feet stroke, the other 43 by 11-feet stroke. These engines are for the Mississippi River, and the latter will be, it is claimed, the largest and finest engine ever built for those waters.

—*Louisville Manufacturer and Merchant.*

The Dayton Cam Pump.

Our engraving represents an improved direct and double acting steam piston pump, which, it is claimed, is absolutely positive in its action, simple in construction, and economical in the use of steam. The principal feature is the mode of working the steam valve by means of a cam bolted on the piston rod and moving with it. By the shape of this cam the stroke is rendered slower at each end, thereby giving time for the water cylinder to fill. A full stream is thus insured, and the pump is prevented from cushioning against the water when the cylinder is but half filled. The arrangement is such that the valve cannot be thrown into such a position as to shut off steam and stop the pump. The operation of the mechanism needs no further description, as the reader will readily understand the adaptation of the various parts to each other from an inspection of the annexed illustration. It will be seen that there are no dead centers and that the action is absolutely positive. The arrangement of the cam movement, in connection with the piston, causes the water valves to lift and to set easily and without jar, thereby saving the wear and tear of valves and seats. The maximum of speed is attained when the valves are lifted and the water is flowing.

The manufacturers, in enumerating the various advantages of the apparatus, point out especially the simplicity of its construction, strong and durable material being used, and the various parts so constructed as to be readily accessible. There are no small intricate steam passages to fill up with dirt and grease, and the water valve chambers may be easily opened to reach the valves. The steam valve, being of the plain slide description, is also not liable to become out of order.



THE DAYTON CAM PUMP.

By the greatly increased use of steam power, within the last few years, it has become indispensable that some way be found for keeping the water in boilers at a constant and uniform height, and without variation. For this purpose hundreds of inventions of steam pumps, injectors, and devices of different kinds, have come before the public; many of them of value, but still having defects that ought to be overcome to give assurance of perfect safety from explosions, arising from low water and the sudden injection of water at such times. Economy of fuel has also become a most important consideration in the use of steam power, but has, up to a certain point, been unattainable from the impossibility of pumping hot water.

All of these defects of feeding boilers, and also the requirements of a good boiler feeder, have been carefully studied and experimented upon, and the result is the presentation to the manufacturing public, and to all parties using steam, the DAYTON CAM PUMP as the most economical, durable, and effective Boiler Feeder in the market. Especially so is this in regard to economy and positiveness of motion, which is absolutely necessary to pumping hot water successfully. The Cam Pumps are feeding water into boilers at a temperature of 250° F.; and in hundreds of instances are feeding water at a temperature of from 212° to 225° F. The reason of the ability of the Dayton Cam Pump to perform this difficult work, and where all other pumps have failed, is its peculiar movement attained by the Cam motion, causing the water valves to commence closing before the stroke is completed, and being absolutely closed at the commencement of the return stroke; a peculiarity which no other pump possesses.

Pumping returns from steam heating apparatus is a new and special feature in the Cam Pump, and one that commends itself to all parties using steam for heating purposes; such as heating Public or Private Buildings, Drying Kilns, Laundries, Oil or Rendering Establishments, Distilleries, etc.

In large buildings where steam is carried long distances, and through great length of pipe and coils, extreme difficulty has been experienced in conducting the water back into the boiler, besides annoyances frequently arising from a cracking noise in the coils, and from the return pipes freezing up before reaching the boiler. All of these difficulties have been obviated by the use of the Cam Pump in pumping directly from the return pipes, without the use of tank or trap, back into the boiler. It makes no difference how hot the water may be, and even if live steam from the boiler reaches the pump it will continue its work pumping the same back directly into the boiler.

These pumps which have been in use for some years have been proven to be thoroughly reliable, and, owing to simplicity of construction and durability, have given general satisfaction. They are made for and adapted to all the various duties of a first-class steam pump; are manufactured especially with a view to economy in use of steam—do not require skillful attendance, nor is there anything about them that an ordinary mechanic cannot keep in order and repair. The designs of these pumps are to have them equal if not superior to all others; also to combine strength, simplicity and durability. Messrs. Smith, Vaile & Co., have accomplished this, and manufacture a first-class pump in every respect. They manufacture the following description of pumps:

Wrecking Pumps, Hydraulic Pressure Pumps, Laundry Pumps, Hotel Pumps, Low Pressure Pumps, Tank Pumps, Fire Pumps, Locomotive Pumps, Acid Pumps, Vacuum Pumps, Quarry Pumps, Oil Pumps, Gas Works Pumps, Brewery Pumps, Soap Pumps, Boiler Feed Pumps, Distillery Pumps, Tannery Pumps, Vinegar Pumps, Marine Pumps, Bleachery Pumps, Crank and Fly Wheel Pumps.

Further information in regard to these pumps can be obtained of The Bullard Machine Co., 14 Dey Street, New York City, who are the Eastern representatives of the house.

The Chase Elemental Steam Governor.

The governor herewith illustrated, though belonging to the centrifugal class, contains a new application of a well-known principle, which greatly increases its efficiency.

The centrifugal principle may be assumed as absolutely correct for governing purposes, provided it is untrammelled in its action; that is to say, a pair of governor balls suspended from frictionless pivots, and free from attachments of every kind, will, by their rise and fall, obey and indicate to absolute perfection the changing speed of the engine.

But certain obstinate difficulties are met at the outset in attempting to impose upon the balls the duty of operating the governor valve. The governing power is at best extremely feeble, because the balls, however heavy, are, when in operation, in exact equipoise between two equal forces, like a scale beam, and are hampered and clogged in their movements by the slightest connection with anything outside of themselves. Accordingly, any system of jointed arms, levers, swivels, valve-stems, etc., for connecting the governing power with the governing valve, is a serious hindrance to accurate working.

The usual methods of constructing governors necessarily entail three principal faults: First, friction, especially the friction of the steam-packing on the valve-stem; second, lost motion, resulting from loose joints, etc.; third, the unbalanced steam pressure on the valve-stem, tending to force the stem out of the stuffing-box. Friction and lost motion are the sole causes of "surging" in the governor; for if, by reason of loose joints or connections, the governor balls are allowed the least motion without moving the valve, or if, through friction of joints or steam-packing, the operation of the valve is not precisely simultaneous with the changes of speed in the engine the inevitable result is a spasmodic action of the governor. The unbalanced steam pressure on the valve-stem has the effect of imposing a variable duty on the governor, according to the variable boiler pressure.

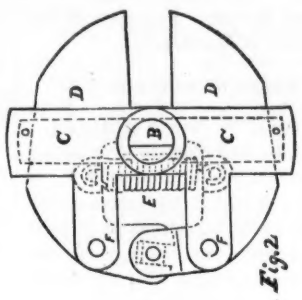


Fig. 2

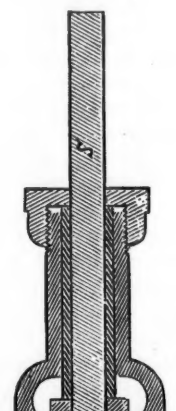
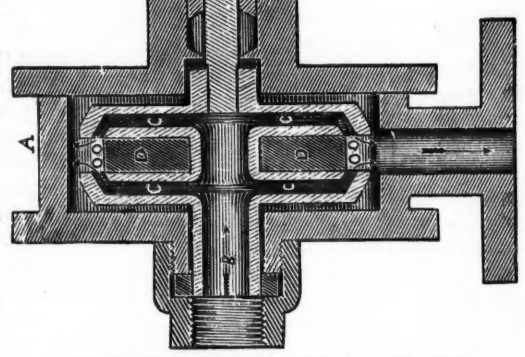


Fig. 1.



THE CHASE ELEMENTAL STEAM GOVERNOR.

The method by which the Chase Governor meets these difficulties is made up of two leading ideas: First, to enclose the centrifugal mechanism of the governor in the same chamber with the governor valve; and second, to locate the centrifugal force in the valve or valves themselves. The first idea effectually obviates friction of steam-packing and unbalanced pressure; for since the centrifugal mechanism itself is immersed in the steam, there is no need of any steam-tight connection between it and the valve, and for the same reason there can be no unbalanced pressure.

The avoidance of lost motion is accomplished in a manner equally effectual. The governor valves, two in number, are themselves made to revolve about an axis in such a manner that the centrifugal force acts on them directly, without the intervention of any auxiliary parts whatever; they are, in fact, *centrifugal valves*. A spiral spring is employed as the complement of the centrifugal force to open the valves when the speed slackens, and this spring is attached directly to the valves, stretching from one to the other across the axis of revolution. Hence the two requisite forces—the centrifugal force and the force of the spring—may be said to *reside in* the governor valves, and of course lost motion is impossible.

The practical arrangement of the parts will be understood by reference to the cuts. Fig. 1, is a vertical, longitudinal section, and Fig. 2, is an end view of the interior parts removed from the case. The machine consists essentially of a stationary, hollow, cylindrical case, *A*, and the centrifugal mechanism enclosed in the same. The centrifugal mechanism consists of the hollow revolving flyer, *B*, the valves, *D D*, and the spring, *E*, the whole being driven by the shaft, *S*. The flyer, *B*, is furnished with two pairs of flat, hollow arms, *C C C C*, with ports, *O O O O*, near their outer ends, opening inward toward each other. The two valves, *D D*, are flat blocks of metal, one being fitted between each pair of hollow arms, so that by moving out and in they cover and uncover the ports. The valves, *D D*, as seen in Fig. 2, are pivoted and supported at one end, *F F*, so as to move in arcs of circles, and the spring, *E*, is shown connecting the two valves. The upper valve, Fig. 2, has a slotted arm projecting downward from the pivot, *F*, and the lower valve has an arm projecting upward with a fork at right angles with the former, and furnished with a square swiveled block, which plays in the slot of the upper valve, the object being to cause the two valves to move together. An equalizer of this kind is necessary to counteract the alternating action of gravity on the valves in their upper and lower positions. The steam, as shown by the arrows, enters the hollow flyer, *B*, through a pipe screwed into the hub of the case, thence into the hollow arms, *C C*, and through the ports, *O O*, into the interior of the case, *A*, from whence it passes out through the base flange to the engine. As to accomplishing practically the ends proposed, the advantages of the arrangement described will be readily understood. The valves being entirely supported and guided by the pivots, and suspended between two vertical valve-seats so that their weight does not bear upon the same, are as near frictionless as possible, and by the arrangement of ports are independent both of the pressure and impact of the steam. This point, in connection with the direct-acting spring, insures the *accurate working of the valves through minute distances*, which is the great object to be gained. As to the durability of the machine there can be no reasonable doubt. The flyer with its hollow arms, lugs for pivots, etc., is cast in one piece, with nothing to unscrew or get loose. A packing-ring on the open end of the flyer bears against the hub of the case to prevent leakage of steam. This ring revolves with the flyer, and any undue wear or friction of the same is prevented by a thrust-bearing on the end of the shaft, as shown in the general view of the machine. The shaft is provided with a stuffing box, so arranged, that no steam reaches the journal. The pivots have long bearings, and very slight motion. The working edges of the valves and ports are made of composition to resist steam cut, and all parts are amply strong and heavy.

This Governor is manufactured by the Chase Machine Co., Boston, Mass.

E. & A. Betts, of Wilmington, Del., makers of heavy machine tools and compound steam pumps, report trade as still very dull, although they confess to a much greater inquiry for tools since the new year came in than for three months previous.

The Growth and Present Position of the Science of Machines.

BY PROFESSOR A. B. W. KENNEDY, C. E.

[*From "Journal of the Society of Arts."*]

I have to night to endeavor to give you a sketch of the development of a science, or branch of science, in which the members of the Society of Arts may be supposed to have some special interest—the science of machinery. Like other sciences, this one began to grow long before it existed. Anything like a complete scientific treatment of machines—their form and objects and dimensions—is of very recent date, and even the first faint traces of such a treatment do not date back more than a century and a half. Without going back to Hero or Archimedes, however—to say nothing of Aristotle—I must start at a somewhat earlier period than that I have named, if I am to give you, as I hope to be able to do, any connected account of the ways in which machines have been viewed and treated by the men most capable of thinking about them, from the time when they began to put their ideas into writing—from the time, that is, at which their ideas first became known to us. We shall find that it is hardly possible to say exactly when these ideas first took anything like a scientific form, and it is not a question in which one can feel any great interest. It is more important and more instructive to notice that we can trace continuous, uninterrupted development, step by step, from Ramelli and Leising right on to Tredgold, Willis and Rankine, Monge and Hachette, Redtenbacher, and Leuner, and Reuleaux. It is the course of this development which I wish now to indicate to you.

At the outset, let me just remind you that it is not the growth of the machines themselves about which I have to speak, but the growth of their theory. Many names that are familiar in connection with the former have little place in regard to the latter, as you will find, and *vice versa*. Nor have I this evening to go directly with the growth of the science of mechanics, which I find had, with a little oversight, been announced as my subject. The general course of the connection between mechanics and machine science has been something like this: At the very beginning mechanics was certainly identical with the science of machines, but, although this was the case—although, that is, the science of mechanics contained all that was scientifically known about machines—yet we shall find that the two were in reality very far separated. The engineer made his machines with scarcely any knowledge of mechanics, the mathematician evolved his mechanics with scarcely any reference to machines. In time, the nominal connection between them grew weaker, as the science of mechanics received higher and more general treatment, while, again, later still, we find certain portions of that science specially connected with engineering treated by themselves as "practical mechanics," the more general treatment of the subject for its own sake being called "theoretical mechanics." By this time, however, machine science, or some part of it, had begun to have separate existence, and stood beside, rather than coincided with mechanics.

With this much of introduction I may enter at once into my subject.

The literature of machinery dates from the latter part of the sixteenth century, and then it certainly makes an excellent start. Within a few years of each other appeared the "Mechanicorum Liber," of Guido Ubaldus (1577); the "Theatrum Instrumentorum," of Besson (1582); and the "Arteficiose Machine," of Ramelli (1588), each of them a substantial folio, such as a modern publisher would scarcely venture to bring out, and a modern public would hardly purchase very largely.

Let me indicate to you, as briefly as I can, the view of their subjects taken by the writers I have named, and others of the same epoch. Its most noticeable characteristics is perhaps the absolute separation between mechanics and machinery which I have already mentioned. In the time of Archimedes, the mathematician was the engineer; the student of mechanics was the inventor of machines. During the centuries that had passed over the world since then their relative position had altogether changed. The bulky "Mechanicorum Liber"—which consists of treatises on the balance, the lever, the pulley, the wheel and axle, the wedge and the screw—contains little that had not been given by Greek mathematicians centuries before. The problems are much the same, the point of view from which they are looked at is much the same, the solutions are much the same. Nominally, they have to do with physical data and phenomena; actually, they are no more than geometric exercises worked out in the study. But while the science of mechanics was thus in its infancy, gradually becoming a not unimportant branch af mathematics, the class of men to whom in time it was to be of the most direct value—the forerunners of our present engineers—had found themselves face to face with a very different set of problems. They had had to make pumps and water wheels, mills, apparatus for land and water transport, hoisting apparatus, bridges and roads and viaducts, and so on. Every one of these brought them into direct contact with nature. Their difficulties were not connected with lines and circles, and mathematics could help, as yet, very little in solving them. They had to deal with some of the most complex problems in physics—problems which, even now, we have not completely mastered; and physical science was as yet unborn. It must be admitted that the cut-and-dried lever and wedge and wheel of the mathematician, and his neat geometric figures cannot have appeared to the engineer, struggling mightily to utilize and control forces which he could not see and energies which he could not understand, to have much direct bearing on his work. We cannot wonder that, when at length he became articulate, his utterances took a form very different from those of writers on mechanics.

The "Mechanicorum Liber," as I have said, is a collection of treatises on the mechanical powers; that unfortunate jumble of apparatus which has played the part of the "old man of the sea" to machine science, and which we have scarcely yet got altogether thrown from our shoulders. It is purely theoretic and its theory is, in general, sound enough and useful, of course, now that we know how to apply it. At the time, it was no doubt regarded as a mathematical book, the "simple machines" only illustrating mathematical problems, and not as setting forth in any way the principles upon which machine design was based.

The "Diverse et Arteficiose Machine" of Ramelli, and the "Theatrum Instrumentorum" of Besson, are much more interesting to us. The authors were both men of distinction in their time, Captain Augustus Ramelli being an engineer in the service of the "Most Christian" King of France, to whom he dedicates his book, and Besson, a doctor of mathematics.

Their books, therefore, which are very similar in form, will enable us to form some idea of the way in which the best engineers of that time looked at their work. Ramelli's, I may mention, is given, chapter by chapter, in both French and Italian; Besson's is in Latin, but a French translation of it was published in 1596. They consist solely and simply of descriptions of machines. There is absolutely no reference to general principles, not even to the mechanical powers. One plate (the engravings in the "Arteficiose Machine" are extremely beautiful) follows another, and for each there is a separate description. A connection is recognized between machines having the same general purpose, but this purposive connection seems to be the only relation distinctly realized by the authors. Ramelli, *e.g.*, begins his book with a hundred and thirteen machines for raising water. Each one has a plate and a description to itself, and each description begins in the same way: "C'este cy est un autre façon de machine par laquelle." . . . . "Une autre façon de machine par laquelle." . . . . "L'effet de ceste autre façon de machine est de faire . . . . monter l'eau," and so forth, and goes on to detail the whole construction *de novo* from the suction-pipe to the discharge-nozzle. In this way, nearly every machine is described many times over; each one comes first worked by a water-wheel, and then by a man or an animal. Then the same machine reappears, with such minute alterations as the substitution of a figure of Neptune for the pipe through which the water is discharged, &c. But each time the whole description is repeated. Further on, come other machines, possible and impossible, treated in just the same way. A screw lifting-jack, for instance, is a machine for lifting a prison door off its hinges, and after being described separately once, is several times re-described in this particular application. A wrench is a machine for breaking the bars of a grating, and so on.

The authors of these early *theatri* view each machine, as a whole, only as one piece of apparatus, intended to do one particular piece of work. They recognize that, as a fact, it is made up of any number of different pieces; but, as soon as any one piece has become part of the machine, it seems to lose its identity; it no longer has any separate existence. An exactly similar piece in the next machine has to be again described, and so on in the next, and the next. Everything, moreover, as I have said, is looked at purposively in the most specialized fashion. The general ideas of, and of course the corresponding words for, pump, crane, hoist, wrench, and so on, are wanting. One is a machine to lift water from a well by means of a man; another to lift water from a river by means of a man; another to lift water from a well by means of a water-wheel; one to raise water for a fountain by means of a water- wheel; another by which a man can raise water for irrigation; and so on with the other classes of machines. Then, further, there is no critical examination of the machine whatever; not even a statement that one is better than another, or simpler or more efficient. There is nothing but a statement of the machine's purpose, and a description of its construction. Ramelli's descriptions are very detailed, his plates being carefully lettered throughout. Besson's descriptions, on the other hand, are not nearly so minute, for the reason, among others, that his system of references is not a very convenient one. To avoid putting letters on his plates, he uses special names for top and bottom, right and left, calling them septentrionale, meridionale, orientale and occidentale, (these words being printed on every plate), and also special names for the corners, and then indicates, by the help of these, the portion of the plate in which any particular detail is to be found.

It must, of course, be remembered that the machines described in the *theatri* had no actual existence in many cases. Which did exist, and which did not, is, of course, now impossible to say, but certainly many of them are physical impossibilities (the lazy-tong bridge and the ship-lifting lever, for example). Ramelli's machines are drawn in such minute detail that I cannot help believing that he actually made models of them, from which his drawings were made. Besson, on the other hand, while far less minute in his details, contains fewer machines which are obviously mere inventions never practically executed.

The drawings in all the works of this time are, of course, in perspective, not arranged in plan and elevation—an improvement which was not long in coming.

I have endeavored to give you some notion of the light in which the machine appeared to the very earliest authors who gave it a place in literature, at a time when as yet machine science did not exist. We have now to trace the growth of this special branch of literature and the development of the science to which it gave rise.

The attempt to connect mechanics with machinery was soon made. In 1608, the first volume of Leising's "Theatrum" was published, in which the editor, mourning over the lamentable ignorance of practical men, incorporated a translation of a short Latin treatise, lately published, on "The Proper Foundation and Understanding of the Balance and Weight," by "that learned and honorable physician and mathematician, D. Eualterus Herminus Rivius," to which he added some general chapters on the meaning of the word machine, the scope of machine study, the origin of machines, the first inventors, and so on. But, as was to be expected, the introductory treatise, which is to give all readers full instruction for the understanding of all the machines, has, after all, very little to do with what follows. The author soon gets tired of his high horse, and descends to very perfunctory descriptions of his plates, which are to a great extent inferior reproductions of those given in the earlier and larger *theatri*.

The work is notable, chiefly on account of the distinct recognition in it, by an engineer, of the fact that his art had also a science. For, although many former works on mechanics had professedly treated of the science of machinery, it is obvious that, to the actual engineer—the veritable constructor of pumps and water-wheels, and other such "engines"—no such science existed. He worked away at his clumsy, but useful contrivances, without saying—or, at least, without writing—much about them; but the lever and the balance, in their mathematic form, were wonders to him, mysteries—things hard to be understood, but greatly to be respected. He did not recognize at first that they had much connection with his work, although he was continually making use of them. And this is not to be wondered at, for the theorist delighted chiefly in describing the enormous loads which could be raised by them, and the smallness of the effort required for that purpose; their levers would do anything—on paper. But he, poor fellow, found that the nearest approach he could make to the mechanician's lever was a ponderous, unwieldy wooden bar. It certainly gave him a very distinct "mechanical advantage;" but then, the effort required to move his load was something out of all comparison with the breath, or the touch of a straw, or pull of a thread, which ought, with a real lever, to do such wonders. And, worst of all, his lever required a very considerable effort to move itself, and that very few of the paper levers seemed to do. Thus, altogether, we cannot be astonished that he failed to discover at first any definite connection between his own machines, which were so hard to move, and these wonder-working contrivances, that did so much with so little trouble. They belonged to distinct *genera*. Herr Leising is not moved to astonishment over his pumps and bridges, and lifting-jacks; it is only of the "lever" that he tells us, very philosophically, that, "when we consider the matter, we shall find that those things which perform wonderful actions must spring from wonderful causes." "Is it not extraordinary," he says, "that an extremely heavy load can be easily raised by adding another weight to it?" and proceeds to discourse on the wonderful qualities of the circle, "the most beautiful, complete, and strong of all figures," and, following Aristotle, traces to these all the mechanical wonders of machines.

The timid attempt of Leising to combine mechanics and engineering was soon followed by bolder steps in the same direction. The work of Solomon de Caus, "Des forces Mouvantes," was published in 1615. It differs from its predecessors in several points. There is a distinct recognition of the connection of machinery with physical science generally, and there is really some attempt to place machine problems on a scientific basis. The attempt breaks down altogether, as did most other such attempts for more than a century after the time of Caus; but it is not with its success, but with its existence that we have here to do.

His book commences with a series of physical definitions and theorems, and then, after examining the "mechanical powers," he goes on to "problems," which are, for the most part, such as require for their solution simply the description of a machine, old or new. Between the theorems and the problems there is no direct connection, but a stage had been reached at which it was recognized that engineering problems were based on physical and mathematical science; and that was a great deal. But the sciences had to advance much further before they could be actually applied to the complex problems of engineering, so that at present they could simply be put side by side. It was reserved for after generations to show the real nature of the connection between them.

(*To be continued in our next number.*)

Pond's Tubular Boilers.

These boilers are made with double heads, A. A., Figs. 1 or 5; if of cast metal, either steel, iron, or phosphor bronze; if riveted, of the best boiler plate of hammered charcoal iron. In the first mentioned—the cast heads, the holes for the tubes are cored out, or made in the casting, thereby saving the trouble and expense of drilling, having only to be reamed out so that the tubes will fit exactly. When made of boiler plate, the best flange iron is swaged between dies to the proper shape, then, being riveted together at the outer edge or rim, they are ready for boring out for the tubes. Another method of forming the heads is to take two plain disks of boiler iron and rivet them on to a cast iron ring, of the width of required space inside the heads; then drill and ream the holes for the reception of the ends of the tubes.

These boilers are being made, as ordered by the buyer, in any of the above named methods.

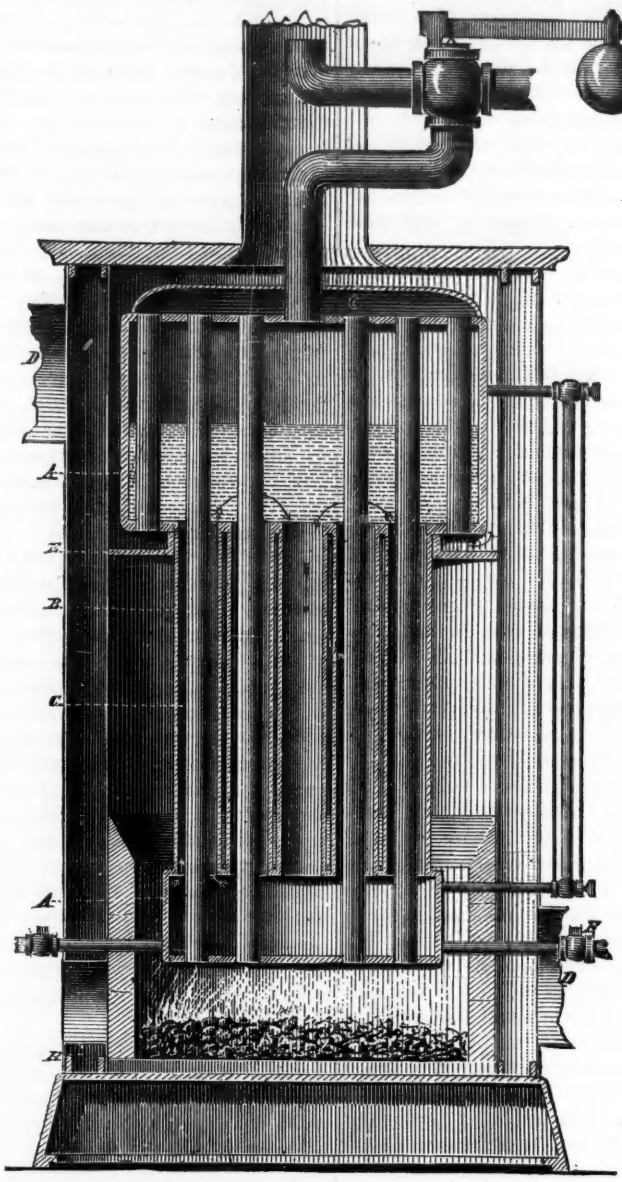
Having completed the double heads, the tubes are set in the following manner, viz.: The larger of the two sets of tubes B. B. (Figs. 1 or 5), are placed in position, the ends of each being attached to the inner plate of each head—the length of the boiler being determined by the length of these tubes—the tubes are then expanded so as to form a shoulder on each side of the plate. The heads being thus connected by the larger tubes with inner plates, the smaller tubes C. C. (Figs. 1 or 5), are then placed in position passing within the larger tubes B. B., and connecting the outer plates of the two heads A. A., and are shouldered and fastened to them in the same man ner as the larger tubes are to the inner plates; thus forming the strongest possible mode of bracing the boiler lengthwise against a pressure from within or against compression.

In the horizontal boiler (Fig. 1,) the fire is under the head and sides of the large flues, passing over which, and the head farthest from the furnace door, the flames and heated gas passing downward enter the small tubes through which it passes to the chimney or smoke stack over the front of the boiler, as shown by the white lines in the cut. This boiler may be set in an iron casing, or in brick in the usual way.

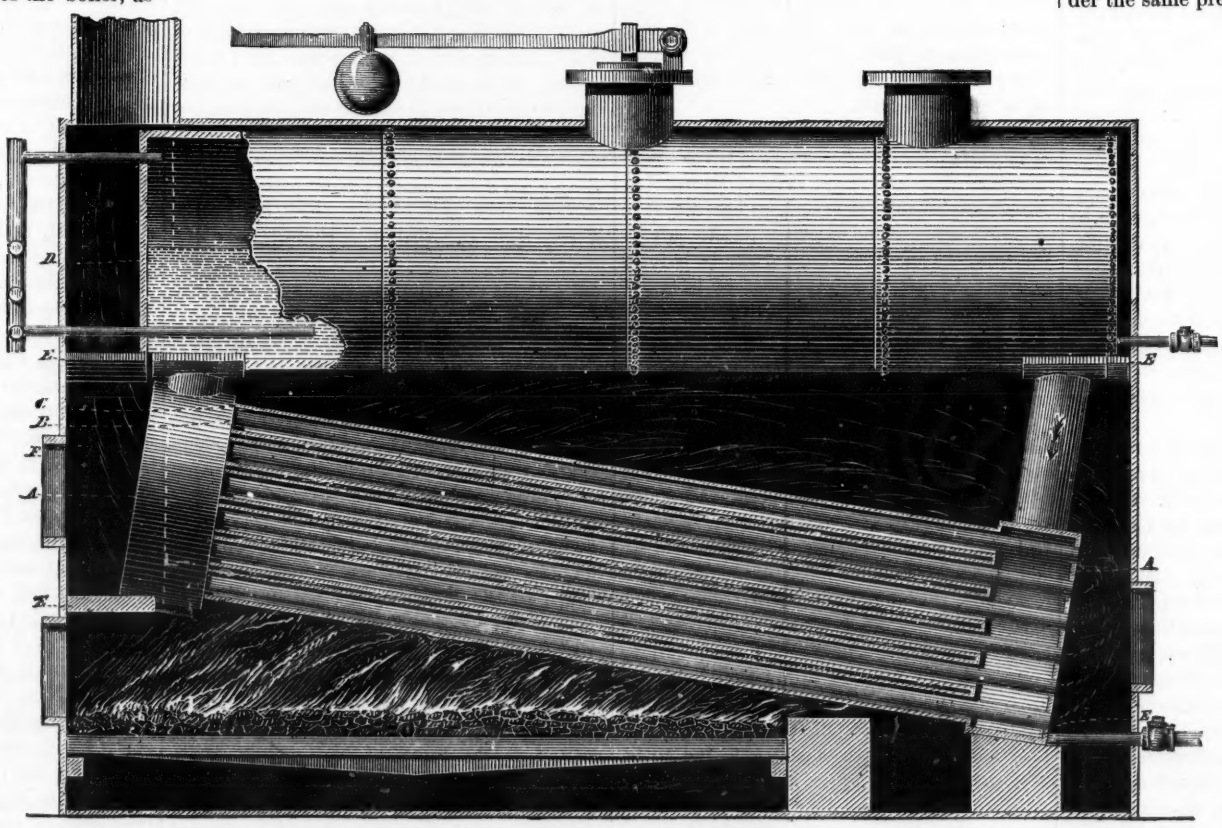
The vertical boiler (Fig. 5,) has the fire under the lower head, the heat passing up around the large tubes, as well as through the small tubes C. C. With this form of boiler the baffle plate G. (Fig. 5,) is used, which directs the heat down through the short tubes in the upper head, whence it passes up outside the head to the stack. The plate E, on which the boiler rests, cuts off nearly all the heat from passing up on the outside of the tubes directly to the stack.

The baffle plate is adjustable and can be raised for starting the fire, thereby giving full action to a direct draft.

The vertical boiler is also made with a water cylinder and steam drum the same as shown in D. (Fig. 1,) to which the heads are fastened by the flanges E. E., giving them very large water and steam space.



POND'S VERTICAL TUBULAR BOILER. FIG. 5.



POND'S HORIZONTAL TUBULAR BOILER. FIG. 1.

These boilers have a *positive and rapid circulation;* the space between the water and the fire tubes not being over a quarter of an inch, and the water, which is spread out so thinly over a large heating surface, is evaporated with great rapidity, generally making a hundred pounds pressure of steam from cold water in *four minutes* from the time of starting the fire.

They are about one-half the weight of other boilers of a given size, and have a larger heating surface in a given space than is possible to obtain in any other form of tubular boiler, having *more than double* the heating surface of the ordinary tubular boiler of the same measurement.

An explosion of a steam boiler having a positive circulation has never been known; this very important fact has been almost entirely overlooked by those using boilers, though of the utmost importance, concerning not only those investing their money in steam generators, but the public in general, who are more or less exposed, in their daily travels along the streets of our cities, to explosions that might take place at any time in any of the hundreds of boilers placed under the side walks.

The reason is obvious why the danger of explosion is less in boilers with positive circulation: So long as there is any water in the boiler—of positive circulation—it is in motion, and in circulating through the tubes covers all parts of the boiler, maintaining an even temperature, so that no part can become overheated so long as there is any water to circulate, and if the pumps are started no damage can occur, for the water will not be thrown suddenly upon overheated surfaces.

The Stone and Sand used in the construction of the Exposition Buildings at Paris, are obtained from pits and quarries situated on the grounds.

Plumbago as a Lubricant.

While Plumbago was known to possess valuable qualities as a lubricant, and its use was recommended by the writers on Friction early in the present century, it was only considered as an article to be of service in extreme cases, where the pressure was so great as to force from between the bearing surfaces, oils and greases, or when the bearings had become heated so as to preclude their use. In fact it was looked upon only as a lubricant to be used in an emergency or when all else failed.

Rennie, in 1829, mentions Plumbago in a somewhat more favorable manner, and while he did not deem it of sufficient importance to subject it to tests says that "in all cases where plumbago was used, it lessened friction." Arthur Morin, a few years later, made experiments and tabulated the results. His tables have been accepted by all writers since that time as authority. His allusions to the use of plumbago placed it in the catagory of articles for use on coarse bearings, under excessive pressure, or where bearings were cutting or hot. Later writers have added but little to the stock of information. They have generally but repeated the utterances of those that preceded them. We are not aware that any attempts were made to determine its value for general use, which is the occasion of some surprise, as the inference might very properly be drawn that an article which would arrest cutting, and cure hot journals, might possibly possess value as a preventive. We have alluded in former articles to tests of plumbago made at the Stephens Institute, which, taken in connection with its practical and eminently successful use for years, demonstrate conclusively that plumbago, when *free from frictional impurities*, of the *proper quality* and *properly prepared*, approaches nearer the point of perfection for general use than any other lubricant.

The Stephens Institute tests were made under the conditions to which all the oils and greases are subjected, that is to say, upon the same testing machine, the same bearings under the same pressures, and at the same varying speeds, and in each instance *when it was exhibited in the right condition, that is, free from frictional impurities, free from powdered plumbago, and in uniform flakes of the proper size,* it was attended with results favorable for plumbago, as compared with oils and greases, in point of endurance and frictional resistance. Friction matter should be avoided in plumbago as well as in oil or grease. Plumbago from which the frictional impurities are not removed may be of service upon cutting or hot bearings, but for general use is of no value. The same may be said of finely powdered plumbago. We are not surprised at the estimation in which it was held by the early and later writers, in view of the fact that not until comparatively recently has plumbago been properly prepared as a lubricant. It will not do to reason with regard to plumbago, as the Irishman did about whiskey. When some one with whom he was drinking pronounced the whiskey bad, he said, "No, it is not bad, no whiskey is bad; but some whiskey is not as good as others." Impure plumbago is not a lubricant; it is *bad, positively bad,* and its use throws discredit upon what otherwise would prove to be the most valuable and economical in the whole list of lubricants.

F. W. P.

The Telephone has been introduced in Germany. At a recent trial before the Emperor, a functionary proposed to call the instrument a "Fernsprecher," meaning a "Far talker." The name was adopted and is now a part of the German language.

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NEW YORK, FEBRUARY, 1878.

Dangerous Boiler Plates.

The means devised by careless and sordid manufacturers to cheapen the cost of making steam boilers are often such as should bring the blush of shame to the cheek of every one detected in them, and put steam users more on their guard against being imposed upon. We do not believe that boiler makers, as a class, are indifferent to the results that may follow the use of weak, poorly-constructed boilers, but that many of them are criminally negligent and overreaching in their efforts to gather pelf by employing unsafe material and unskilled labor there is too much evidence to doubt. It will, at first thought, seem profitless to take plates from an old discarded boiler, turn them inside out, and work them into new boilers; yet this kind of business has been carried on to an extent that would surprise the unsuspecting public, were the facts and references by name laid before them by means of the press.

The old plates are pickled so as to remove rust and scale, then turned outside-in by passing through the bending rolls (cold). By this process blisters on the outer surface are buckled while laminations that previously had not endangered the safety of the shell spread open, thus paving the way for a rupture, and possibly a dangerous accident when a full pressure of steam is brought upon them. Burned plates are thus made to appear like new and reliable ones, the defects being placed out of sight. Old plates have been so turned and used again by boiler makers in this city and elsewhere; the strong competition in low prices seeming to offer a temptation to make boilers as poor and flimsy as possible without spoiling the sale of them. Another unscrupulous method of increasing profits at the sacrifice of safety and durability, is connived at by the manufacturers of boiler plates, in furnishing unstamped plates of low grade and quality to boiler makers, to be afterwards stamped "C. H., No. 1,' "Fire Box;" or, the mark of any other grade desired by the purchaser of a boiler. This dodge has been practiced to such an extent that State governments ought to provide for a searching investigation regarding stationary boilers as thoroughly as the United States government does regarding marine boilers. Honest boiler makers find it impossible to compete successfully with those who employ inferior plates, shoddy tubes, and careless workmanship. The purchaser of a boiler generally thinks he knows too much about steam engineering to be deceived by any ordinary artifice, and this very knowledge often prevents his inquiring very closely into the character of the work he accepts and pays for. It may be urged, that in many localities where large numbers of boilers are employed, a system of government inspection is provided for, which should prove a safeguard against using dangerous boilers, or working them beyond the strain they are, with safety, capable of sustaining. To draw it mildly, the government inspection of land boilers, almost always falls far short of what it is designed to accomplish. The inspectors are generally better informed about political matters than about steam generating, and the instances where careful and thorough examinations of boilers have been made by them are very rare indeed. Often a certificate is granted without having seen the boiler at all. The frequency of boiler explosions where certificates have been granted by government inspectors has weakened faith in their supposed value. More caution and discrimination is needed on the part of boiler purchasers, and less inclination to let the price alone control the placing of an order. Every plate should be thoroughly tested with the hammer before it is allowed to go into a boiler. This will develop concealed flaws (which are liable to appear in plates of the best makers), and give a comforting assurance of staunchness when finished. The entire time required to do this will be more than compensated for in the feeling of security thereby given. We have met with a few cases where the ends of tubes were protected by thimbles *in new boilers.* If a tube will not stand the strain of expanding without being strengthened by a thimble, it ought never to be placed in a new boiler. Instances are numerous where the fire sheets of a boiler are of a better and stronger quality of iron or steel than the remainder of the shell. It would be safer to construct the whole boiler of the poorer material, for where a good plate is riveted to an inferior one the action of the heat, in alternately contracting and expanding both, will cause them to yield unequally, the weaker giving way to the stronger, and in time causing a leak or rupture.

The building of unsafe boilers is carried on to an extent that calls for closer scrutiny on the part of steam users, and an awakening on the part of authorities whose business it is to guard against endangering public safety. The time to make investigations is before, rather than after the sacrifice of life and property.

Cheap Machinery.

The quantity of low-priced and inferior machinery that has been made and sold during the past four years is so great that, as soon as general business becomes brisk and shops are well supplied with orders, many of them will need a special department for repairs; and, if our observations are not at fault, in a few shops this department will be more extensive than any other—at least until the shop is fitted up anew. There is a surprisingly large class of mnnufacturers that will not learn that the lowest-priced machinery is not cheap, except they acquire that knowledge by long and costly experience. Machine tools, with proper care, ought to last an average lifetime, and the occasions for repairs should be few and far between. Many shop owners argue that while business is slack, and they need extra work to keep their men employed and in their places, economy is exhibited in repairing semi-worthless machines and tools rather than in buying new ones. We advise those holding this opinion, to keep a separate account of repairs—time, cost, loss by breakages, delays, &c.—which at the end of a year or six months might show some interesting (if not gratifying) totals. Inferior machines are generally finished up to look well, and are likely to deceive purchasers who are not practical mechanics. If a purchaser does not understand machinery, he should secure the advice of some disinterested party that does, before making an investment.

Reform in the Patent Office.

In no branch of the civil service has reform been more needed than in the Patent Office, and we are pleased to see that the present Commissioner is determined to interpret the laws relating to the granting of Letters Patent in a manner calculated to be of most benefit to the inventor and the public, and in a great measure to correct certain abuses that have gradually crept into the practice of the office within the past twelve years. He has recently issued a circular to the Examiners of Patents, requiring them to see that specifications contain specific statements as to the state of the art prior to the applicant's invention, and that if a device is an improvement on a previously patented article, that fact be also declared; the object being to enable any one having but little knowledge of patent matters to perceive what the exact condition of the art was prior to the grant of the last patent.

To any one having had experience in patent matters, either as patentee, assignee, manufacturer of patented productions, dealer in patents, and the public in general, *save a few patent solicitors,* this will be regarded as a most judicious and much needed reform, and we are encouraged to believe that this will not be the only measure of reform which will be inaugurated under General Spears' administration of the patent office, but that he will continue to increase the efficiency and usefulness of the office to the end, that patents granted for meritorious and useful inventions will be fully protected, and not made subordinate to inferior and worthless devices, by carelessly overlooking the claims of the former while examining and granting a patent to the latter for subject matter already covered by the prior patent.

If an original and really useful improvement has been made, the specifications should state concisely *what old matter has been borrowed, to whom it rightfully belongs,* what new matter has been added to it, and if a *better result* has been produced by the substitution or addition of the latter? The well merited success with which the inventors of all our first and original devices and processes met with, was in a great measure due to our American system of rigid examination of applications for Letters Patent, to ascertain what original or new matter the alleged invention contained before granting a patent for the same. The public knew that a patent granted *then* meant something more than a piece of artistically engrossed paper held together by means of a piece of red tape and seal, but that it gave the inventor the exclusive right to manufacture and sell his invention, in which he was protected and sustained by the courts, and liberally encouraged by the public. If the inventor of a useful and salable device had not the means to put his invention upon the market, he had no trouble to procure all the capital required, for patents were in those days regarded as safe and profitable investments and were much sought after by our manufacturers.

The main object governing the practice of the office in those days was to pay particular regard to the *quality* of the patents granted and not the *quantity;* within the past twelve years a system diametrically opposite to that has been adopted (and practiced with more or less degree of liberality by the numerous Commissioners) by which the *quantity* and not the *quality* seemed to be the great desideratum. Each Commissioner in turn claimed that great liberality should be extended to the inventor, and that a patent should be granted him if his alleged invention contained the least novelty, regardless of whether it was useful or not, or how much of it had been anticipated by prior patents. Now may we not ask in all candor, in what way is the inventor or the public benefited by the grant of a patent which can not be used, either from want of usefulness, or from the fact that it infringes on others rights and would involve law suits of the most costly and disagreeable kind? If there is any liberality in the Government granting such a patent we fail to see it.

The question is often asked by Patent journals, parties whose existence depends upon soliciting and procuring patents, and whose "terms are invariably in advance," what harm is there in liberally granting patents for novel devices, or liberally construing the law in favor of the inventors. As this journal has no interest whatever in the procurement of patents, or in patented productions, save to encourage that which is good, and condemn that which is bad in the arts and manufactures, we can afford to answer that question, and point out where, in our judgment, it should be discontinued. First, it destroys the usefulness and efficiency of the Patent Office. Second, it discourages the first inventors of really useful and valuable discoveries; for they find that before they are ready to put their inventions upon the market that patents have been granted for similar devices, a majority of them infringing on some part of their patents, and each preventing the other from procuring capital to manufacture their invention, as no one will invest where there is a likelihood of a law suit, and if the first inventor puts his own money into the business, his profits will be consumed in defending his patent. Thirdly, it encourages a class of scallewags who have no inventive ability whatever, but by keeping themselves well posted on the recently issued patents, select those that are likely to have a run, and set themselves to work to circumvent and "invent around" said patent, and by the aid of a "no patent no pay" attorney, succeed in procuring a patent which is of no value save to sell to some one not well posted in patent matters, or to trade for Western lands, which, as a dernier resort, is generally regarded as a fair equivalent in value. This class of inventions do a vast amount of mischief where they are purchased by innocent parties who invest largely in machinery to manufacture them, and find out when it is too late, that they are involved in litigation which is likely to swamp them.

Fourthly, there is another class of original but useless inventions, invented by parties who are far removed from manufacturing centres, and have but little knowledge of what *will sell,* or what the *public demand,* they are the outgrowth of *false representation* of patent journals which tell of the wonderful success attending the invention of small articles—how one party got immensely rich by the invention of what was known as the return ball, a simple wooden ball with an elastic string attached to it; how another party made an independent fortune by attaching a piece of rubber to the head of a lead pencil, and how success would attend any one who would improve any of the following articles: Churns and Churn Dashers, Self-Closing Farm Gates, Washing Machines, Folding Clothes-Driers, Cold Handle Sad Irons, Earth Closets, Whiffletrees, and other similar articles. These statements were copied into the country papers and commented upon. The result was that men who had but little mechanical skill or inventive ability, neglected their regular business and spent valuable time and money over some one of the above named articles, or something of less value; and patents were issued by the thousand for such trashy inventions. It would be safe to say that not one in a thousand have ever been manufactured, or are in the market to day. This was called, by the Patent Office, stimulating and encouraging American industry and inventions. Why not call it by its right name—stimulating and encouraging an incompetent class of patent solicitors to impose upon the credulity and ignorance of the people.

We do not wish to see the avenues of procuring patents for meritorious and useful inventions in the least blocked, and if we interpret General Spears' instructions right, they will not be; but we do hope that some measure of reform will be put in force, by which the grant of a patent by the Government will be of some protection to the inventor without his having to go into Courts to have his rights sustained.

Owing to an unusual pressure of matter about the time of going to press, there are several things crowded out of this issue which will appear in our next.

Second-Hand Boiler Tubes.

Just before going to press a friend handed us a late issue or the *Engineering and Mining Journal*, of this city, containing the following attempt at defending the old boiler tube business explained in our last :

RE-HEATED BOILER TUBES.

"The utilization of waste material is one of the most important departments of industry, as anybody admits. The prolonged hard times have stimulated invention and economy in this respect among our manufacturers; and while we do not sympathize with any business which is based on deceit, and offers inferior products under false pretenses, we are decidedly inclined to encourage any honest enterprise which finds its profit in restoring to use what would otherwise be cast away.

A practice has recently arisen of re-heating old boiler tubes, drawing them down to smaller size and putting them into new boilers. The manufacturers engaged in this business offer to guarantee the strength of the tubes; and if reasonable care is exercised in the choice of the old material, we do not see why the guaranty could not be safely given. It appears to us that the process of re-heating and drawing down would increase the strength of the tube, improve the quality of the iron, and perfect the weld.

The AMERICAN MACHINIST of January last contains a vigorous editorial attack upon this manufacture, in which it is asserted that the product is a dangerous sham; that the process forms weak spots in the iron by pressing into it the superficial rust and scale; that thin spots already existing are elongated and made worse; that re-drawn tubes of the same length and diameter vary considerable in weight, thus proving their unreliability; and that if second hand tubes are to be used at all, it is in the universal opinion of boiler-makers with whom the editor has conversed, 'much safer to put them in a boiler without re-heating or re-drawing;' and that the use of such re-drawn tubes is one of the occult causes of explosions, never reached in the coroner's inquest.

Now all this is very important if true, and very disgraceful if not true. The article contains no proofs but only assertions; and these assertions, in the absence of proof, seem to us improbable. So far as the opinion of certain boiler-makers is concerned, it cannot be quite separated from their interests and their jealousy of a new rival industry. If the AMERICAN MACHINIST is in possession of any facts on the subject, we hope they will be made public at once. Let us have tests of weight applied to new tubes and to re-drawn tubes, and certified by responsible parties. Let us have instances in which re-drawn tubes have collapsed, with or without the sequence of a baffled coroner's jury. Let us have tests of pressure, such as are, or ought to be, universally applied to all tubes before they are put into boilers at all.

We understand that the manufacturers of the re-drawn tubes consider the attack of the AMERICAN MACHINIST upon their business an unwarrantable outrage. This it would be, in the absence of proofs to support it. But it would be equally an outrage to denounce the motives of that journal without waiting to see upon what grounds its assertions are based. Meanwhile, the manufacturers themselves have an excellent remedy. Let *them* produce the facts and certified tests. They will thus transform the attack into an advertisement. To properly accredited facts from either side our columns will be open."

The main issue we made against the old boiler tube business is not even touched upon in the above article. To make this plainer we repeat one of our sentences: "Were these spurious tubes sent out under statement of their true character the responsibility of using them would rest with the boiler makers who buy them; but the lithographed circular, mailed by the managers of this peculiar business, conveys no impression that they are other than new tubes, and a guarantee is offered that every flue will stand as much pressure and work as easily as any flues that are made."

The circular referred to is, omitting price list, names and addresses, as follows:

"We are now prepared to fill orders for boiler flues of the sizes and at the prices indicated on the next page, at —— additional discount for cash or approved (short) paper. We guarantee every flue to stand as much pressure and work as easily as any flues that are made, and shall be glad to receive your orders and will endeavor to fill them to your entire satisfaction."

If the editor of the *E. and M. Journal* can derive any ideas about the "utilization of waste material" from the above announcement alone, we will credit him with unusual penetration.

Desirous of gaining information of this peculiar industry, we called at the works before publishing a word about it, and were told by the superintendent that no outsider would be admitted; that they made *new boiler tubes*, and sold *none but new tubes;* that the old tubes purchased by them were worked over into new iron by a private process, and that afterwards this iron was made into boiler tubes in the same way that all other boiler tube makers pursue. If any one chooses to sell second-hand tubes made to imitate new ones, *stating just what they are*, there is no deceit in the transaction, and the purchaser must assume the responsibility of using or re-selling them. So when oleomargarine is sold under its true name, the seller is not at fault, but when old tubes are sold for new ones, and oleomargarine for butter, the swindled public should enter a strong protest.

So far as we can learn, there is but one boiler maker in the United States that has any interest in the manufacture of tubes: so we cannot see any "rival industry" for "certain boiler makers" to be jealous of. On the contrary, if old second-hand tubes can be made as reliable, safe and durable as new ones, and sold ten to fifteen per cent. cheaper, the greatest benefit is conferred upon boiler makers throughout this country, and the facts should not be kept secret. If tests are wanted to strengthen the position we have taken on this question, there are practical ones that have been made by boiler makers which we shall publish hereafter. If any boiler makers find these tubes good and substantial, our columns are open to publish any communication from them.

Rolling Stock Exempt from Taxes.

The systems of taxation vary in different States of our Union, and under their provisions some kinds of property are made to contribute more than their just share of revenue to the government. Manufacturing interests and all kinds of real estate are always roundly taxed, while church property—not only of a religious, but also of a secular character—goes exempt. Between these two extremes most business interests are made to pay, in somewhat different proportions, their shares of the public burden. Favoritism in making assessments is an evil that probably always will exist in spite of legislation to prevent it, but total exemption of that which is justly taxable is another evil, the remedy for which is available and should be applied. There is no valid excuse for making a wholesale exemption in favor of railroad r olling stock, nor would a law granting to railroads this extraordinary privilege be allowed to stand upon our statute books, yet this is virtually what is conceded to them, and year by year other business interests are overtaxed in sustaining this unwarrantable exemption. The responsibilities rest with those who have the making of our laws as well as those who are entrusted with their enforcement. Why have locomotives and cars been excluded in making up the assessment rolls? If it is because they cannot be accredited to definite localities let it be made the subject of legislative inquiry, and if special enactments are required let them be passed. The street railroad companies in our cities and towns pay taxes on their cars and dummies, though if the trunk lines are perpetually exempt from paying taxes on their equipment the street roads should likewise be exempted. Both enjoy special privileges under government charters, and both in justice are bound to contribute their full quota to the support of the government on the same basis that private property does.

We have no definite statistics at hand to show the total value of rolling stock in the State of New York, but a close estimate can be made on the basis of one trunk line. The N. Y. Central R.R., with 1000 miles of track, owns $3,260,000 worth of rolling stock, according to Poor's Manual. There are 5,585 miles of track in the State, and supposing all the roads to be equipped in proportion to the Central, there would be $18,207,100 worth of rolling stock on all roads in the State. The last State tax collected was $3\frac{1}{4}$ mills on each dollar of assessed valuation. This would make the whole State tax (excluding county and local taxes) on rolling stock $62,966 at the above estimate. Here is a big drop in the public bucket; one which has been allowed to trickle away year after year, and the loss of which the taxpayers must make good. Is this perpetual loss of revenue to continue? Legislatures will not move in the matter until compelled to do so by force of popular indignation. If the (independent) press would co-operate in discussing this subject, much good could be accomplished.

Advantages of American Mechanical Productions.

The manufacturers of Europe seem to be surprised at the success which our machinery and small tools are meeting with in their home markets, as well as in other countries which were heretofore supplied with their productions. They lay the cause of this successful competition to our labor-saving machinery and ingenuity, while they are only the minor causes. Our manufacturers have taken a new departure, and adapted a system of manufacture which distinguishes their productions from those made in Europe in several very essential features, to wit:

Instead of imitating and reproducing the same type of machinery as made by our grandfathers, with all its clumsy appearance, disproportionate parts, inferior material and bad workmanship, they prefer to originate new and artistic designs, having the material distributed to the parts in proportion to the amount of strain or work which they are required to perform, the materials selected for their strength and durability, the workmanship close, accurately fitted and highly finished. The American type of horizontal steam engines are noticeable cases of this system.

We found the steam engine an unsightly clumsy affair, with a fly-wheel out of proportion to the size of the engine, a frame of heavy iron, with square corners and flat sides, on which was bolted the cylinder with numerous badly fitting bolts, and the whole bolted to a solid foundation of brick or stone. An ungovernable governor presided over a company of disjointed and unreliable co-workers, each performing its part in an unharmonious and noisy manner.

The engineer, whose ill fate it was to attend to her many wants, was kept busy between the engine and boiler. The boiler, as a water boiler, was a success, as it made no pretensions to being a steam generator, being fully satisfied if it produced steam enough to feed the hungry engine, regardless of the labor required or the amount of coal consumed.

We took this engine and reconstructed it: Instead of having the frame, cylinder, and crank supports in separate parts, we converted them into one semi-cylindrical piece of casting; where the corners were square we rounded them off; we covered the outside of the cylinder with a jacket of wood to keep it warm, and on the inside employed an indestructible, self-adjusting piston packing which requires but little attention. Various methods of cutting off the steam at the proper time are employed, the most simple and effective of which we will put to our engine and connect it to the eccentric, and adding to it a governor, which gauges to a degree of certainty the uniform quantity of steam required, we have described the few principal parts required to produce our perfect engine, beautiful and artistic in design, powerful yet noiseless in action.

There are many imitators of our engines in Europe, but their best are but poor imitations.

The manufacture of shafting, pulleys and hangers has reached a state of perfection within the past fifteen years, that reflects a great deal of credit on several well-known manufacturers. Every thing which the mind could conceive of to make them perfect and simple has been adopted. A perfect true running line of shafting is of as much importance as a perfect engine or tools, and to "line up" a line of shafting without having a perfectly true shaft, and pulleys, and hangers, which shall be self-adjusting, and admit of the shaft finding its own level without strain or twist on the bearings, was next to impossible. With these very desirable features our system of shafting and hangers save time in lining up, lessens friction, saves oil and wears longer.

Our standard small tools, such as taps and dies, solid and shell reamers of all kinds, gear and milling machine cutters, and machinists' tools in general, have been improved upon to such an extent as to make them so wonderfully perfect that it would seem impossible for any mechanic of ordinary ability to do a bad job with such tools. A few years ago such tools could not be bought in the stores; they had to be made in the shop as they were wanted, and at a great deal of trouble and expense, and then they were seldom very perfect.

At present all the standard tools required in the machine shop can be had at any machinist supply store, and they are, without exception, perfect in every respect; they are more reliable than those made, as required, in the shop, and much cheaper. It has been but recently that those tools have been exported to any great extent, as the high price has been against them; but they have begun to learn that "the best is the cheapest," and are now ordering from all parts of the world. It is not only in machinery and machinists' tools that we excel, but in numerous other articles. Our Consul-general at Berlin gives some valuable information, and makes suggestions to our manufacturers as to what shape they should put their tools into in order to make them sell in Germany—"wooden plane, by altering their shape!" Our Consul might as well tell us that our axes would sell by altering their shape. It is the shape and quality of our tools which makes them sell at home, and once the Germans get accustomed to the use of our tools they will appreciate them in their present shape. We would, therefore, advise our manufacturers to stick to the present shape of their tools. The cast iron plane was regarded by our wood workers as much of an innovation on the old wooden plane of their daddies, as the cast iron plow was regarded by our farmers an innovation on the old wooden scratcher of their grandfathers. Yet our mechanics were liberal enough to give it a trial, and intelligent enough to appreciate its value. The ease with which the bit can be adjusted to the finest cut, without removing it from the work, the removing and replacing of the bits without having to strike them with the hammer, together with other labor-saving features, make the cast iron bench plane a very valuable tool. The manufacturers of those tools made a great mistake in putting them upon the market at such a high price, which prevents their sale at home and abroad.

We will continue this subject in our next.

Usurpation of Streets.

New York is a long-suffering city. Afflicted with Tweedism for a number of years, and burdened with a debt of about $150 per head for every man, woman and child of her entire population, she is now brought to the humiliation of having her free, open streets obstructed and made hideous by frameworks of iron posts, beams and girders against the outspoken wishes of property holders, whose rights are trampled upon and despoiled *without the shadow of compensation*. Protests have been unavailing, the Courts have as yet afforded no substantial relief, while day and night the streets and avenues of this city are being seized upon by two private corporations under the slogan of "rapid transit." These corporations, well aware of the injustice of their title to public property, proceed upon the assumption that "possession is nine points of the law," and hasten to occupy the public streets and squares as rapidly as possible, pushing forward most actively under cover of darkness. "Sam," said one African chicken thief to another, "it am very wicked to steal." "Dat am a great mor'l quesshun," replied Sam, "which we hab no time to 'cuss just now; hand down another chicken." The elevated rail road companies are getting a firm hold of the streets of this much cheated city, leaving the question of right to be discussed hereafter. Was any great city ever before so imposed upon?

New Type of Steam Air Engine.

BY E. L. BUCKUP.

In submitting this engine to the notice of the public, I wish to explain in the first place, why it is neither a steam engine nor an air (caloric) engine, but instead an engine worked by the expansion of compressed air heated by steam. The object I have in view is to get all the power contained in the heat of the steam that can practically be got out of it, and at the same time to make an engine fully equal to any steam engine in regard to compactness, size, and power. Every engineer and man of science will agree with me, that the steam engine wastes, and does not use the greatest part of the heat contained in the steam. The high-pressure engine throws it out into the open air, and the condensing engine into the condenser, where the surrounding or injected water removes it; in the latter case with a gain to the engine of 15 lbs. atmospheric pressure removed; but still it is undeniable that the steam leaving the cylinder, at the moment of the exhaust-port opening, contains nearly all the heat it had when entering the cylinder. A small portion of this heat is utilized again by heating the feed-water before it enters the boiler, but all the rest must be thrown away, because it would take more power to drive the steam back into the boiler than it could give out again in the engine.

In my steam air engine I use a common steam boiler, of about a quarter the size belonging to a steam engine of the same power. In the second place, I use an air cooler constructed in a similar manner as the condensers of steam engines; this cooler contains compressed air, which is cooled by water surrounding the cooler pipes. Two separate volumes of the compressed air, which are contained in the so-called changing cylinders, are alternately cooled and heated, and communicate their increased and decreased pressures respectively to the opposite sides of the driving piston of the engine. A slide-valve opens and shuts the communications between the engine and the cooler. The steam is led into the engine cylinder by two small pipes, provided with globe-valves to regulate the flow of steam into it, in such a way as to keep the temperature of the air in it and in one of the changing cylinders connected with it, to about the same degree as that of the steam. The engine works in the following manner. The air that is to drive the piston forward is first let into the engine from the cooler, where it is kept at a pressure of 50 lbs., for instance, it then comes in contact with the steam after the communication with cooler is closed, it thereby increases in volume to such an extent that its pressure is raised to 100 lbs. and over, and drives the piston to the end of its stroke, when the engine turns the center; the pressure remaining in the cylinder is discharged into the cooler, the valve then closes, and the air remaining in the engine is cooled down, and as its pressure decreases in consequence to about 25 lbs., which would constitute the back pressure, the forward pressure on the opposite side of the piston being increased at the same time to about 100 lbs. The effective pressure would be in this case 100 less 25 equal to 75 lbs. per square inch.

If all the heat that is required for the increase of pressure of the air had to be drawn from the boiler at each stroke of the engine, my engine would not, indeed, save much fuel in comparison to a steam engine; but such is not the case; on the contrary, the largest amount of heat is transferred from the air to finely divided metallic substances, such as wire-gauze, plates or wires, through which it has to pass on its way from the hot parts of the engine to the cold ones, and from which substances it takes up again the greatest part of the heat given out to them before, when it returns to be heated again. In this way the boiler has to supply only one-tenth part or thereabouts, instead of the whole amount of heat required to give to the air the necessary expansion and pressure.

Aside from the economy in fuel, the essential requirements of an air engine to compete with a steam engine, are: In the first place, it must be capable of giving out just as much, or more power if possible, as a steam engine of the same size; and, in the second place, the air must be heated in such a manner, that even in the largest size engines the fire cannot destroy any parts of the engine exposed to its action. Both these points I have gained in the construction of my steam air engine. To these I may add that the engine must also have a positive forward driving power during the entire length of stroke, and to be under perfect control of the engineer to stop, start, or reverse the engine at any moment. In this respect my engine is also equal to the steam engine; it has a slide-valve (or other valve) that lets on the pressure on the forward driving side of the piston the moment the engine turns the center. The engine is, of course, double acting, and the pressure on the piston is in the beginning of the stroke, about one-half the maximum, which is reached about the middle of the stroke, and diminishes again towards the end.

The data which I give in regard to power and consumption of fuel and other features of my engine, are all derived from actual experiments, partly with engines built by myself and other machinists, partly with an apparatus constructed by me to test the expansion of air under different degrees of heat, when the air is kept always at the point of saturation with moisture.

All air engines (often called caloric engines) built up to the present day have been deficient in regard to power in proportion to their size, with the single exception of one built in Dundee in Scotland. I got acquainted with the working of that engine while I was in that country in the year 1845. It exerted a power of fully 100 horses, replacing a steam engine of the same power, and using the cylinder of that engine with a saving of coal of 75 per cent., using 1000 lbs. of coal per day, instead of 4000 lbs. used by the steam engine. The engine was condemned, after driving the works of the Dundee Foundry Co. for over a year, because it was found impossible to prevent the vessels in which the air was heated from being burnt through repeatedly.

From recent experiments, made partly in Pittsburg, partly here, I find that air expands when heated by direct contact with steam $\frac{1}{100}$ part of its volume for every degree of heat. The steam in this case keeps up the moisture in the air to its point of saturation. When on the other hand air is heated by fire, it expands only $\frac{1}{500}$ part of its volume for every degree of heat, as is well known.

The exact degrees of heat and the corresponding expansions that I have tried, each repeatedly, are:

Air heated from 65° to 212°, increase 147°, expansion $1\frac{4}{7}$ of its volume. Air heated from 40° to 262°, increase 222°, expansion $2\frac{4}{5}$ of its volume. Air heated from 40° to 278°, increase 234°, expansion $2\frac{5}{5}$ its volume.

The expansive force of air gained in this way, when applied to compressed air is amply sufficient for the construction of air engines as small and compact as any steam engine.

The consumption of fuel of my steam air engines of from 20 to 100 horse power, is from 400 lbs. to 800 lbs of coal per day; it cannot be larger, but may be even less. They cannot be made, advantageously, smaller than about 20 horse power, because in smaller engines the hot parts would be brought so close to the cold parts, that they would mutually destroy their effects.

Rules and Regulations.

We continue from last issue our publication of shop rules. The first set of rules below are those of a steam engine factory, and the second a large locomotive works.

REGULATIONS.—No. 1.

1. "Ten hours labor shall constitute a day's work, from 7 A. M. to 12 M., and from 12.30 to 6 P. M. On Saturday work will cease at 3 P. M., making sixty working hours during the week."

2. "The *persistent* practice of coming late on the part of any man in my employ will be sufficient evidence that he makes no effort to be punctual, and consequently will not be allowed to commence work until 12.30 P. M."

3 "The starting of the engine will be the signal for the closing of the doors and the *commencement of work*, and the stopping of the engine the *leaving off of work*. Preparatinos for leaving off work *before* this time will not be tolerated. *Ten hours work is expected of every man.*"

4. "The strictest economy and care in the use of Tools, Files, Emery Cloth, and material of every description is required of the workmen, and infractions of this rule will be met by a reduction of wages."

5. "The taking of visitors into the shop by the hands is prohibited. Reading, Smoking, and unnecessary conversation during working hours is also prohibited."

6. "Workmen finding it necessary to absent themselves, will make application to the Foreman. When unexpectedly detained from work notice must be sent the Foreman immediately. Regularity on the part of all persons employed will be indispensable."

7. "The pay roll will be made up at the end of every month, and payment made on the 10th of the following month. *When convenient*, money can be had on account, on the eighth, sixteenth, and twenty-fourth days after the 10th, and then notice must be given at the office of the amount desired before noon of those days. If either of these days should fall on Sunday, payment will be made on Monday."

8. "These Regulations are considered a part of the contract with every person in my employ, therefore no hand need complain if discharged for non observance of them."

REGULATIONS No. 2.—WORKING TIME.

"Each workman is required to be at his place and commence work when the signal is given, and will be fined one hour for preparing to quit before the stop signal is given. He must report himself to the Time Office and his Foreman when late."

"A strict account will be kept of all late time, and those coming in between 7 and 8 A. M. and 1 and 2 P. M., will be fined one hour."

"Those habitually late, and those absenting themselves without notice of such intention to their Foreman, will not be retained in employ."

"Employees leaving the Works before 12 M. and 6 P. M., must report to their Foreman and the Time Office, to secure their time for the day."

"The week of labor will close at 6 P. M. on Saturday, and payment of wages for the same will be made on the regular pay day in the following week, at a fixed rate per hour."

TIME KEEPING.

"Workmen are required to report to the Time Keepers as follows: Number of hours per day; name of job and machine or engine; time employed on it; when commenced and when finished. No time will be allowed workmen unless these particulars are complied with"

"Each workman should see personally that Time Keepers get his correct time daily."

"Workmen expecting to be absent on Monday, should report their time for the week to the Foreman and Time Office before leaving the Works on Saturday, and those absent on Monday without having so reported, should send their preceding week's time to the Time Office on that date."

"On entering the service, each employee is required to record his name in the Pay-master's Register. Unless so registered, he cannot draw pay."

"Wages will be paid to workmen on the regular pay-day, after signal to quit work is given."

"Applications for payment of wages will be made by the workman in person, to the Pay-master."

"Employees must report to the Pay-master personally before leaving the Works on pay-day, any errors in wages paid them. In case of deficiency, the balance due will be enclosed in the workman's envelope for the following week."

"Employees expecting to be absent on pay-day and wishing to arrange for any member of their families to draw their pay, must personally notify the Pay-master."

"Employees running two machines on Piece Work, will not be paid day work for time lost by one machine on account of break down, or while waiting for work."

WORK.

"Each workman must know before commencing a piece of work, that it will finish to the sizes marked on the sketch or card given him, whether the work is to be completed by him or others."

"One casting will be made from each new pattern, and examined to know that it will finish to the required sizes before more are made."

"Spoiled or defective work must be immediately reported to the Foreman."

"The damage for spoiled work will be charged to the workman, unless occurring from a reasonable cause, and being made known at once to the Foreman."

"A workman accepting a piece of work from another to finish, will be held responsible for any errors in work that have been made by preceding workman."

"Workmen on regular jobs, are responsible for the completion of their work, at the time specified on the lists furnished."

"Stock material must be returned to its original department."

"All workmen are required to keep their work neatly piled and properly marked, and each succeeding workman must see that the mark is continued on work finished by him."

TOOLS.

"Tools of a general character, such as Drills, Reamers, Taps, etc., must be returned to their proper places in good order, or if damaged, must be reported at once. Careless damage will be charged to workman."

"Workmen are not allowed to make new tools without the consent of their Foreman, or use the tools of others without the consent of the workman or Foreman."

"Each employee is responsible for the tools placed in his charge on commencing work, and upon leaving the employ, he must deliver the key of his box or drawer, and satisfy the Foreman that his stock of tools is complete and in proper order, before a settlement will be made."

"Economy in the use of material of all kinds, Oil, Waste, Emery, Files, etc., is strictly enjoined on every workman."

"New material must not be cut when pieces can be had that will answer, and all surplus material must be immediately returned to the proper place."

"When a new file is needed, the old one must be returned."

ORDER.

"Cleanliness and good order must be observed throughout the Works."

"Each employee is required to keep his Bench, Vise, Lathe, Forge, Machine, or whatever tool and place at which he is employed, cleaned and free from rubbish."

"Machines must be kept clean at all times."

"Particular care must be taken to put all combustible matter, such as oily waste, etc., in a safe place to prevent any chance of fire."

"All obsolete or imperfect castings, forgings, lumber, etc., must be removed to the proper place at once."

"All castings and forgings, soon as ready, must be delivered to the proper departments for finishing."

"All work soon as completed at one machine, must be delivered to the next succeeding machine."

LABORERS.

"A workman will not be allowed to call a laborer to perform any part of his work that can be done by himself."

"Laborers are not employed to wait upon workmen, but to assist where more than one man is required."

BEHAVIOR.

"Smoking, Reading, or Loitering during working hours, are positively prohibited."

"Abusive, Vulgar, or Profane Language, Quarreling and Fighting, will result in immediate dismissal."

VISITORS.

"Strangers are admitted only on passes from the Office."

The Chinese Government regards favorably a sample lot of Sharp's American rifles sent to China for trial, and will probably give the manufacturers a contract for one million military rifles.

New Publications.

A treatise on the Steam Engine, by Arthur Rigg, is a work just brought out by the Messrs. Spon, in which the author gives in a clear and concise manner, with full details the adaptation of new rules and proportions to the present practice in Stationary Steam Engine building. So rapid have been the improvements in this class of work, that the old rules, of no more than a generation past, are obsolete, and in many cases unreliable, so that a work of the practical nature of the one now before us must prove a great acquisition to the mechanical engineer and builder.

To give an idea of the object and scope of the work, we quote the following from the preface :

"The present Treatise is written to describe various examples of Fixed Steam Engines, without entering into the wide domain of locomotives or marine practice ; to give detail of construction, with principles by which their relative proportions may be calculated, and to investigate the more modern application of science to the subject. In order to avoid mathematical forms of expression, which are unfamiliar to practical men, the graphic method of calculation is brought into prominent use, and it will be found that with very little attention a busy engineer can adapt this system to ordinary calculations, for it has the merit of extreme simplicity, and can be employed even where more elaborate systems fail. This work is not, therefore, an elementary treatise or history of the steam engine."

The author deals first with units of measurements, advocating adherence to the ancient standards used in our own country and England.

He then gives "a new and original method by which centrifugal force may be calculated. Several forms of the horizontal engine are next considered, and then follow different methods for constructing all the various details and parts of steam engines."

As an example of the thoroughness of detail entered into, let us look at the table of contents of the next succeeding chapter on the Cylinder, Piston, and Piston-rod. After a general introduction to the cylinder, its functions, position, etc., the contents are : "Mixture of Metals, Patterns, Joints, Water in Cylinder, Clearance, Lubrication, Lubricators, Pistons, Allens, and seven other pistons; Friction of Pistons, Piston-rods, Methods of Fixing Piston-rods in Piston, Cylinder Nuts and bolts, Stuffing Boxes, Packing and Friction of Rods through Packing ; embracing many of the best methods adopted in construction, and entering fully into the minor details. All the parts and diagrams are illustrated in the text, and by finely executed plates appended. Following this are two chapters on the Slide-valve ; and methods of arranging them based on Dr. Zenner's simple diagrams, worked out into convenient form for all ordinary practical requirements. These chapters are equally comprehensive with the former ; including Link Motion, Eccentrics, Expansion-valves, Valve Gear, etc., with experiments on Friction of Locomotive Slide Valves, and Piston Valves.

Connecting Rods, Cross Heads, and Parallel Motions follow, each with a chapter to itself. Crank and Eccentrics, treating fully of their functions and relations to the Main Shaft and Governor, and influence of Crank and Connecting Rods. Governors are handled in detail, and many examples of various patterns and makes are given, and so on, concluding that part of the work devoted to the details of a steam engine with condenser, and the principles of condensation.

As little has been written on Spanners and Nuts, the author gives a chapter on the subject, with tables of reasonable proportions.

"The remainder of the treatise" (to quote) "is taken up by those scientific and interesting subjects which lie at the root of all perfection in the design of steam engines, and which have hitherto been written upon in a desultory manner in fugitive papers, but not in any standard work. A chapter on "Reciprocating Parts, is believed to be the most complete account, hitherto published, of the effect produced by the action of reciprocating parts in modifying the driving power of a steam engine."

The last chapter on Heat, is intended as an outline of the views generally received among engineers on the relationship existing between heat and work.

The work is handsomely gotten up in quarto ; wide margin, with large clean type, embellished with two hundred readily-intelligible diagrams, and ninety-six lithographed plates, containing several hundred illustrations, giving, in a series of examples, most that is new and good in the modern practice of engineers. On the whole, an ornamental work of great usefulness, which deserves the attention of all interested in the steam engine, as engineers or builders, and which cannot but approve itself to them after a careful examination.

The *St. Louis Review*, a journal of the Iron Trade, gives us information of what is doing in that interest in the great Mississippi Valley.

We are glad to greet in each periodical return *Arthurs' Home Magazine*, which is always full of pleasant and instructive matter with which to while away the leisure hours by the fireside and in the home circle.

Ballou's Monthly comes to us in its usual good dress, replete with entertaining matter, sustaining its well earned reputation, as a magazine affording recreation and pleasant relief from the daily toils and humdrum of life.

The *Complete Practical Machinist ;* embracing, Lathe Work, Vise Work, Drills and Drilling, Taps and Dies, Hardening and Tempering, the Making and Use of Tools, etc. By Joshua Rose. Illustrated by 130 Engravings. Henry Carey Baird & Co., Philadelphia. Price $2.50.

This is the title of a 376 page volume lying before us, written in the author's well known, pleasing style, in which a great deal of practical information is given in concise form. It is, in our opinion, most useful to apprentices, as the matter presented is such as skilled machinists should be familiar with.

A Nevada engineer is perfecting a plan for heating a city by means of heat generated in subterranean mines. The plan contemplates a system of pipes for distributing the heat throughout the city. The same operation ventilates the mine.—*Chicago Journal of Commerce.*

Coloring Metals.

Metals may be colored quickly and cheaply by forming on their surface a coating of a this film of a sulphide. In five minutes brass articles may be coated with any color, varying from gold to copper-red, then to carmine, dark red, and from light aniline blue to a blue-white, like sulphide of lead, and at last a reddish-white, according to the thickness of the coat, which depends on the length of time the metal remains in the solution used. The colors possess a very good luster, and if the articles to be colored have been previously thoroughly cleaned, by means of acids and alkalies, they adhere so firmly that they may be operated upon by the polishing steel. To prepare the solution, dissolve ½ oz. hyposulphite of soda in 1 lb. of water, and add ¼ oz. acetate of lead dissolved in ½ lb. of water. When this clear solution is heated to from 190° to 200° Fah., it decomposes slowly, and precipitates sulphide of lead in brown flakes. If metal be now present, a part of the sulphide of lead is deposited thereon, and according to the thickness of the deposited sulphide of lead the above colors are produced. To produce an even coloring, the articles must be evenly heated. Iron treated with this solution takes a steel-blue color.—*Western Manufacturer.*

We have received the January number of the *American Machinist*, a handsome 16 page illustrated monthly devoted to the subject of machinery and machinists' supplies. A very valuable and creditable journal.—*Philadelphia Trade Journal.*

MANUFACTURES.

NEW YORK.

Roberts' Governors are being shipped to the West and Pacific coast in considerable numbers.

D. L. Kennedy's Patent Spiral Punches are fast superseding the old flat punch in the principal boiler shops and engine manufactories.

Robert Brass, 57 Scholes St., Brooklyn, has orders ahead for all the braiding machines he can manufacture. They are built of wrought iron and are much more durable than the ordinary wooden ones. He is also making Traphagen's new boiler feeder.

Fust & Pryibil, 461 to 467 West 40th Street, are running their shops fifteen hours a day in the manufacture of wood-working and other machinery. They will shortly bring out a new smoothing machine for cabinet makers. This establishment will make a large display at Paris.

The American Metaline Company, New York City, have removed from No. 61 Warren street to more commodious quarters at 204 and 206 Green street. Its quarters at the new location gives it three times its former floor space, which, with the facilities afforded by 55 horse power to draw from what it may require, will enable it to largely increase its former product.

The works of the Watertown Steam Engine Co. were founded in 1850 by Hoard & Bradford, on a small scale. The present company was incorporated in 1863. The works cover three acres of ground, and the manufactures embrace stationary engines and boilers, circular saw mills, portable engines and agricultural engines.

MASSACHUSETTS.

The Wason Car Company, of Springfield, recently shipped 50 cars for the Panama railroad.

The first Blake pump was made in 1862. There are now about 11,000 in use, and the extensive works of the company in Boston are running lively on orders.

The Mason Machine Works at Taunton, Mass., have received a contract for a number of locomotives, which, together with orders already on hand for mules and machinery, will keep a force of 500 to 600 men employed till spring. These hands have had a partial rest for several months past.

CONNECTICUT.

John Cotter, Norwalk, is doing a good business, employing six hands, and will soon increase his force.

The Norwalk Iron Works of South Norwalk, have just completed a large Air Compressor, which is beautiful in design, and works admirably.

John Cotter, of Norwalk, is making a new Lawn Mower, patented by W. B. Bartram, which is a decided improvement on previous inventions of this kind.

The establishment of W. & B. Douglas, Middletown, was founded in 1832 for the manufacture of steam engines, and machinery. In 1842 the manufacture of pumps and hydraulic machines was begun, and their trade has been extended so as to cover the whole civilized world.

Fanton Bros., Danbury, report business good, having plenty of orders to keep them busy, and are employing twenty men. They have just built them a fifty horse power engine, with a boiler of sixty-six horse power. They are busy perfecting a new hat-forming machine, which will be of great advantage to the trade.

Charles Parker began business at Meriden in 1832, manufacturing coffee mills in a small shop. He is now principal proprietor of five large works, employing from 500 to 600 men, and producing about 120 different lines of goods, among which are coffee mills, screws, guns, builder's hardware, vises, iron, britannia, and silver plated spoons, and patent spectacles.

PENNSYLVANIA.

Carnegie Brothers & Co., Union Iron Mills, have purchased from the Combination Trust Company, trustees for the Wheeler patents, the exclusive right to manufacture in the United States, bridge structures and parts thereof, roofs for buildings and parts thereof, elevated railway substructure and parts thereof, viaducts and parts thereof, of combined iron and steel, or what is known as Wheeler's ironclad steel.

NEW HAMPSHIRE.

The Swamscott Machine Co., South Newmarket, was incorporated in 1849. Their works cover nearly six acres. The productions embrace steam engines, boilers, steam fittings, gas works, and a large variety of general machinery.

OHIO.

The Dayton (O.) Malleable Iron Works are running to their full capacity. They employ ninety hands, and melt 350 tons of Malleable and 500 tons of gray iron per annum.

The Lake Shore Mill of the Cleveland (O.) Rolling Mill Co. has recently had its capacity increased by the addition of eight new heating and five puddling furnaces.

The Glencoe Iron Works, of Arms, Bell & Co., Youngstown, Ohio, are running full time with sixty hands, the capacity of the works having been doubled recently. They turn out a value of $12,000 per month.

The Ohio Falls Iron Works, New Albany, Ind., are in full operation, with a force of about 300 hands, in the manufacture of bar iron and nails. They turned out during eleven months of 1877, 5,400 tons of merchant iron and 15,000 kegs of nails. They have a capacity of 60,000 pounds per day.

One of the largest machine works in the West is that of H. & F. Blandy, Zanesville, and Newark, O. They manufacture steam engines, portable and stationary, portable saw mills, grist and flouring mills, blast furnace machinery, and every description of foundry and machine work.

The Variety Iron Works, of Cuyahoga Falls, are running their works on full time. In addition to a large amount of orders for wire-drawing machinery from the Cleveland Rolling Mill Co., of Cleveland, O., they have recently received an order for wire-drawing machinery from the Standard Nut Company, of Pittsburgh, Pa. They also manufacture largely all the machinery required for the manufacture of sewer pipe and roofing tile.

The Novelty Iron Works at Cleveland are very busy just now. Fifty men are employed at the establishment. The concern has a large contract for bridge work in Iowa, among other jobs on hand. The Novelty Works built three of the excellent machines in use by the Sheridan Horse Nail Company, a large amount of machinery for the Ohio Barb Fence Company of Cleveland, and have just finished the ironwork of the Youngstown Rolling Mill Company's substantial building A lighthouse for the new water works crib is to be one of the future feats of the concern.—*Trade Review.*

ILLINOIS.

The Union Malleable Iron Works, of Moline, Ill., we are informed, are crowded with work, and are turning out an immense amount of superb material. New inventions are continually bringing them new work, and not the least share of their orders are received from the new Corn-Planter Manufactory.

IOWA.

The Novelty Iron Works, Dubuque, are the largest machine works in Iowa. They manufacture stationary, portable, and semi-portable steam engines, boilers and their attachments, water wheels, shafting, hangers and pulleys ; also barrel making machinery.

INDIANA.

The Bass Foundry and Machine Works. Ft. Wayne, was established in 1853 by J. H, Bass. They produce chilled car wheels, steam engines, boilers and attachments, machine tools, and railroad castings of large variety.

TENNESSEE.

The Tennessee Iron and Steel Company, Chattanooga, manufacturers of merchant bar iron, are running their works double turn, and report orders as plentiful. They propose to add another heating furnace to their plant soon.

Exports.

Dwight Robert has recently shipped some of his 30-inch chucks to Australia.

D. L. Kennedy's Patent Railroad Punches, for punching railroad bars and other heavy work, are being shipped to South America.

Watt, Campbell & Co., Newark, N. J., have nearly completed a large steam plow for shipment to Cuba.

The Rogers Locomotive Works, of Paterson, are said to have received an order for six engines for New Zealand.

The Clayton Steam Pump and Air Compressor Works of Brooklyn, N. Y., are busy on several large orders for air compressors and mining pumps for the West.

The Northampton Emery Wheel Company will exhibit a full line of their wheels at the Paris Exposition next May, and, with the wheels, their style of machinery on which to run the wheels.

L. B. Flanders, of Philadelphia, has recently shipped to South America a number of special tools for use in railroad repair shops, where they are said to have given great satisfaction.

The Niles Tool Works of Hamilton, Ohio, have just shipped to England, two of their special Pulley Boring and Turning Machines and one Pulley Borer to Canada. They have been working their shops full time on orders for the past four months.

STANDARD PRICE LISTS.

Price List of Lap-Welded Boiler Tubes

OF STANDARD GAUGE, NOT OVER EIGHTEEN FEET LONG.

Outside Diameter	1	1¼	1½	1¾	2	2¼	2½	2¾	3
Wire Gauge	15	15	14	13	13	13	12	12	12
Price, per foot	0 23	0 23	0 23	0 23	0 23	0 25	0 29	0 33	0 35

Outside Diameter	3½	3½	3¾	4	4½	5	6	7	8
Wire Gauge	11	11	11	10	10	9	8	8	8
Price, per foot	0 40	0 46	0 53	0 58	0 67	0 85	1 20	1 60	2 25

Machinists' Hand Taps.

V and Franklin Institute Shape of Thread.

3 TAPS TO SET—TAPER, PLUG AND BOTTOMING.

Diameter.	Price Each.	Diameter.	Price Each.
1-4	$0 45	15-16	$1 80
5-16	50	1	2 00
3-8	55	1 1-8	2 25
7-16	60	1 1-4	2 60
1-2	70	1 3-8	3 00
9-16	80	1 1-2	3 50
5-8	90	1 5-8	4 20
11-16	1 05	1 3-4	5 00
3-4	1 20	1 7-8	5 80
13-16	1 40	2	6 70
7-8	1 60		

Machine or Nut Taps.

V and Franklin Institute Shape of Thread.

LONG SHANK.

Diameter.	Price Each.	Diameter.	Price Each.
1-4	$0 60	15-16	$2 40
5-16	70	1	2 80
3-8	80	1 1-8	3 20
7-16	90	1 1-4	3 70
1-2	1 00	1 3-8	4 20
9 16	1 15	1 1-2	4 70
5-8	1 30	1 5-8	5 30
11-16	1 45	1 3-4	6 00
3-4	1 60	1 7-8	6 80
13-16	1 80	2	7 70
7-8	2 10		

Taps for Machine Screws.

Wire Gauge, Size.	Price Each.	Price per Doz.
No. 4	35c.	$4 00
6	35c.	4 00
8	35c.	4 00
10	35c.	4 00
12	35c.	4 00
14	38c.	4 40
16	38c.	4 40
18	38c.	4 40
20	45c.	5 30
24	45c.	5 30

Iron Review.

PIG IRON.—The market is rather stagnant, very little business being transacted. Foundries have, as a rule, but a limited amount of work on hand, and buy only for immediate requirements. The main feature in the trade is uncertainty as to the future, a lack of confidence in the financial stability of purchasers being a serious drawback to business. The numerous failures thus far, in the year 1878, have caused a kind of general distrust, which, it is hoped, will soon wear away, and leave commercial affairs with a brighter outlook. It is thought that the early adjournment of Congress would remove an incubus from trade, and hasten the "good time coming." The advance in price of coal is not yet of sufficient importance to hasten an advance in iron. One or two leading brands of iron can be had at 50 cents a ton less than they were selling for a month ago, but there has been no general change in prices.

When any good sized lot of iron is wanted for ready cash a concession can almost always be obtained. We hear of one sale of 7,500 tons of Allentown, on private terms. But few brokers are selling any iron at all. Late sales include 110 tons No. 2 X Sterling, at $17; 200 tons Sterling Grey Forge, at $16; and 300 tons Sterling mottled and white, at $15.50. We quote No. 1 $18 to $19; No. 2 $17 to $17.50; Grey Forge $16 to $16.50.

Scotch Pig is sold in small lots, at $24 for Glengarnock; $23 to $23.50 for Eglinton; and $25 to $25.50 for Coltness.

MANUFACTURED IRON.—There is a sluggish kind of market, but no disposition to either advance or reduce prices. Store prices remain on a basis of 2.1c. for refined bar, and 1.9c. for common. The mills show some determination to resist further decline.

WROUGHT SCRAP.—There is very little trade—business almost flat. Good scrap is worth 1c. a pound at yard; mixed lots can be had at $21 a ton. The new tariff bill proposes to admit scrap at $1 a ton, and will, if it becomes a law, stimulate importations.

RAILS.—Most of the steel mills are well supplied with orders, and prices have advanced since our last. The New York Elevated R. R. bought at $42.75, delivered, 1850 tons. Some time ago the Gilbert road bought at $41.45, delivered. We quote steel rails $42 to $43 at tidewater, in small lots. In large lots there has been no marked change in price. Iron rails have appreciated somewhat. We quote $46 to $48 at tidewater.

STEEL.—A moderate trade at unchanged prices.

TANK, PLATE AND SHEET IRON.—No change since our last. Trade is not active, but does not decline. Store prices are: Tank Iron @ 2¾ to 3; C, No. 1 Iron @ 3; C. H. No. 1 Shell @ 3¼; Best Flange @ 4¼ to 5; Soft Patch Iron @ 6¼; Boiler Rivets @ 4 to 4¼; Sheet Iron, No. 10 to 18 @ 3; Boiler Tubes list price less 20% discount.

SCROLL SAWS, Fleetwood, Dexter, Lester, Centennial, etc., *at Factory Prices.* Wood & Designs.
LATHES with Jig & Circular Saw Attachments.
TOOLS & HARDWARE for Amateurs, *Machinists, Carpenters,* and every Department of Mechanical Trade. Send stamp for Catalogue, and state *what kind* of Tools or Machines you require.
TALLMAN & McFADDEN, 607 Market St., Philad'a.

Iron Wire.

Nos.	0000 to 6	7 to 9	10 & 11	12	
Cents	9	10	11	11½	₩ lb.
Nos.	13 & 14	15 & 16	17	18	
Cents	12½	14	15	16	₩ lb.

BRIGHT MARKET WIRE..57½ ₱ct. dis. from above list.
" CHARCOAL " ..30 " " "

Cast Steel Wire.

Nos.	⅛ in. to 6	7 to 9	10 & 11	12	13	14	
Cents	23	24	25	26	28	30	₩ lb.
Nos.	15	16	17	18	19	20	
Cents	32	33	34	36	38	40	₩ lb.

25 per cent. discount.

Machinery Wire (soft). Machinery Spring Wire (elastic).

Nos.	00000 to 9	10 & 11	12 & 14	
Cents	15	16	17	₩ lb.
Nos.	15 & 16	17	18	
Cents	18	19	20	

10 per cent. off.

The Worcester Wire Co.

MANUFACTURERS OF

IRON AND STEEL WIRE

OF EVERY DESCRIPTION.

WORCESTER, MASS.

RICHARD DUDGEON,

24 Columbia Street.

NEW YORK.

Maker and Patentee of

IMPROVED HYDRAULIC JACKS,

Punches, and Roller Tube Expanders.

AND

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Steam Hammers.

Communications by letter will receive prompt attention.

Jacks for Pressing on Car Wheels or Crank Pins made to order.

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The best article for regulating forge fires ever invented.

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MIDDLETOWN, CONN.

Also sold by H. PRENTISS & Co., 14 Dey St., New York.

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S. H. WALES & SON, 114 Nassau Street, New York, procure Patents in the United States and foreign countries. Charges moderate. Caveats, Designs, Trade Marks and Labels secured. 23 years' experience. Advice given without charge. Inventors invited to write. Business confidential.

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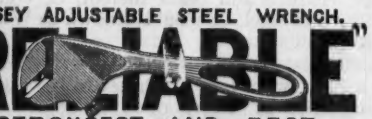

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IRON MERCHANTS,

28 & 29 West St., and 52 Washington St.,

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BOILER PLATE,

BOILER TUBES, ANGLE, TEE AND GIRDER IRON, BOILER AND TANK RIVETS.

Sole Agents for the celebrated "EUREKA," "PENNOCKS," "WAWASSET," "LUKENS," brands of Iron.

All descriptions of Plate, Sheet Gasometer, Girder Iron, &c., furnished to order. We have a large stock of Plates, Sheets, Rivets and Boiler Tubes, &c., constantly on hand.

Prices Given on Application.

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THOMAS & CO.

558 & 560 West Thirty-fourth Street,

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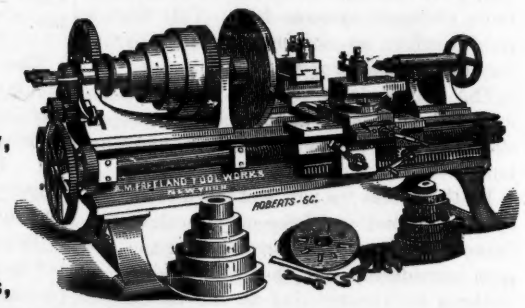
MANUFACTURERS OF

Machinists' Tools,
Mining, Hydraulic and Experimental Machinery,
Patent Office Models,
Surface Plates,
Standard Guide Screws and Special Tools,



ALSO MANUFACTURERS OF

Thomas' Patent Planer Vise,

THE BEST IN THE WORLD. SEND FOR CIRCULAR.

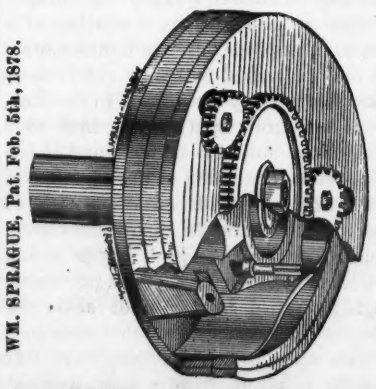
SPRAGUE'S

PATENT STEAM ENGINE PISTON,

MANUFACTURED BY

WM. SPRAGUE & CO.

628 & 630 FILBERT ST., PHILADELPHIA.



This piston can be applied to cylinders of any size and construction, and can be adjusted in 3 minutes without moving the cylinder head, and is guaranteed to save 10 per cent. over any other piston now in use.

Estimates furnished on application, or by mail.

Send for Price List and Circular.

N. B.—Special attention given to repairs of all kinds of machinery.

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Engines and Boilers,

SPECIAL PRICES TO Boilers to Engine Builders.

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Room 1. New York.

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IMPORTERS AND DEALERS IN IRON AND STEEL OF EVERY DESCRIPTION,

Warehouse, 24 and 26 Broadway, and 77 and 79 New Street,

New York City, February 20, 1878.

TERMS, NET CASH IN 30 DAYS. PRICES SUBJECT TO MARKET CHANGES WITHOUT NOTICE.

COMMON IRON.

	Price Per Lb.
1×⅜ to 6×1 Flat,	1 9/10
1¼ to 6×¼ and 5/16 Flat,	2
1 and 1⅛×¼ and 5/16 Flat,	
⅝ and 2 Round and Square,	1 9/10
⅝ and 1 1/16 " "	2
½ and 9/16 " "	2 1/10

REFINED IRON.

1×⅜ to 6×1 Flat,	2 1/10
1 to 6×¼ and 5/16 Flat,	2 3/10
⅝ to 2 Round and Square,	2 1/10
2⅛ to 2⅞ " "	2 3/10
3, to 3½ " "	2 5/10
3⅝ to 4 "	2 8/10
4⅛ to 4½ "	3 1/10
4⅝ to 5 "	3 4/10

RODS, ROUND AND SQUARE.

2 9/10	2 8/10	2 7/10	2 6/10	3	3 3/10	4 3/10
⅝ & 11/16	½ & 9/16	7/16	⅜	5/16	¼	3/16

Ovals, Half Ovals and Half Rounds.

2 7/10	2 6/10	3 1/10	3 6/10	3 3/10
¾ to 2	⅝ & 11/16	½ & 9/16	7/16	⅜

BAND.

1 to 6×⅜ to No 12, 2 5/10

HOOP.

5 9/10	4 7/10	3 7/10	3 5/10	3 3/10	3	2 8/10
½	⅝	¾	⅞	1	1⅛	1¼ & up'ds

HORSE SHOE.

¾×⅜ to 1½×⅝ 3 4/10

SCROLL.

4 9/10	4 8/10	4 4/10	3 9/10	3 7/10	3 5/10
½×16	14	12	10	⅜	½ & 5/16
4 5/10	3 9/10	3 6/10	3 4/10	3 2/10	3
⅝×16	14	12	10	⅜	½ & 5/16
3 5/10	3 3/10	3 1/10	3	2 9/10	2 8/10
¾×16	14	12	10	⅜	½ & 5/16
3 3/10	3 2/10	3	2 9/10	2 8/10	2 7/10
⅞×16	14	12	10	⅜	½ & 5/16

	c.
Norway Bar Iron,	5
" Shapes,	6
Nail Rods, P. & Co., 6c., or U. B.	6½
Angle Iron,	2 6/10
Tee Iron,	3 1/10
Sheet Iron, Common,	3
Boiler Plate,	3 @ 3½
Best Flange,	4½ @ 5

EXTRA REFINED IRON.

Equal to H. B. & S. B. B. H. BAGNALL'S or L. W.

Ordinary Sizes.

ROUND AND SQUARE, ¾ to 2 in.	Price per lb. 2 5/10 c.
FLATS, 1×⅜ to 6×1,	

Extras same as Refined.

ULSTER BEST IRON.

PIERSON & CO. keep in stock a full assortment of this well known extra brand.

Ordinary Sizes.	Price Per Lb.
⅝ to 2 Round and Square, 1¼×⅜ to 4½×1,	3 5/10 c.

Extras on Rounds and Squares.

¼	1 2/10	⅝ and 11/16	2/10
5/16	1 1/10	2⅛ to 2⅝	3/10
⅜	0	2½ to 3	4/10
7/16	6/10	3¼ to 3½	6/10
½ and 9/16	3/10	3¾ to 4	8/10

Extras on Flats.

1 3/10	1 1/10	8/10
⅝×¼ and ⅜ 1 1/10	½ and 5/16 8/10	⅝ to ½ 6/10
¾×¼ and ⅜ 8/10	½ and 5/16 6/10	⅝ to ⅝ 4/10
⅞×¼ and ⅜ 4/10	½ and 5/16 3/10	⅝ to ¾ 2/10
1×¼ and ⅜	½ and 5/16	⅝ to ⅞

4/10	3/10		2/10
1½×⅛ and ⅜	¼ and 5/16		⅝ to 1
1¼ to 4½×¼ and 5/16,			
" ×1½ to 2			3/10
4½ to 6×⅜ to 1			
4½ to 6×¼ and 5/16			
" ×1½ to 2			4/10
6½ to 7×⅜ to 1			
2¼ to 3×2½ to 2¾			
6½ to 7× ¼ and 5/16			
" ×1½ to 2			6/10
3½ to 4×2½ to 3			

Ovals.

8/10	6/10	4/10	2/10
½ and 9/16	⅝ and 11/16	¾	⅞ & up.

Half Ovals and Half Rounds.

1 3/10	1 1/10	8/10	4/10
½ and 9/16	⅝ and 11/16	¾	⅞ & up.

Ulster Horse Shoe, 3 5/10

Esopus " " 3 4/10

MISCELLANEOUS.

Special Rates Given on Application.

Iron and Steel Rails; Railroad Chairs and Spikes; Railroad Fish Plates; Bolts, &c.; Railroad Axles and Wheels; Wire Rods; Screw Rods; Gas and Steam Tubes; Nails; Rivets; Tank Iron. Wrought Iron Beams, Deck Beams, Channel Bars, Star Iron, Octagonal Post Iron, "Upset" Chord Bars, Angle and Tee Iron.

"Universal Mill" Plates.

Plates not over 24 in. wide, ×3-8 to 7-16.
Plates not over 24 in. wide, ×1-2 and upw'ds.
Plates not over 24 in. wide, ×3-16 to 5-16.

All plates over **30** feet long, weighing **1000** lbs. or over, subject to **special agreement only.**

These Plates are not Sheared.

Edges guaranteed perfectly solid, straight and of uniform width, rendering reshearing unnecessary when exactness is required.

PICKS,

Our own manufacture of Railroad, Drifting, Poll, Coal and Mining Picks. Special Price-list sent on Application.

CROW-BARS,

All Steel, 6½ c.

STEEL,

Foreign & Domestic.

English Cast Steel,	16
" Spring Steel,	6
" Tire Steel,	6
" Toe Calk Steel,	6
" Machinery Steel,	9
Bessemer Wire Rods,	3½
American Bessemer Tire Steel,	
" 3-16 up,	5c
" " " " 5-32 up,	5¼
" " " " 1-8 "	5½
" " " " 3-32 "	5¾
" Spring Steel,	5
" Tool Steel,	13
" Machinery Steel,	7
" Toe Calk Steel,	5
" Plow Steel,	6
" Sleigh Shoe Steel,	4
" Bessemer Steel,	7
" Steel Crowbars,	6½

STEEL FORGINGS TO ORDER.

REVIEW.

Business since last report has been quiet, and buyers seem in no disposition to depart from the hand to mouth policy so long in vogue. Prices have, notwithstanding, been well maintained, and the impression seems to be gaining ground that any change must be to increased firmness. This is occasioned not so much by an increased demand, as by the manufacturers having assumed a more decided position against selling at unremunerative rates, and of resorting to combinations to effect this, as in the case of the Hoop and Nail makers. Stocks of Pig Iron are less than this time last year, while on the other hand, at the great iron centres Ore has somewhat declined within a month, and the general prospect does not look very encouraging. The uncertainties of the tariff and silver legislation have, too, a very depressing effect on business generally.

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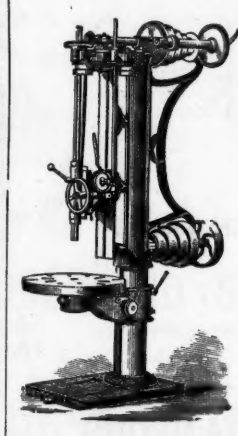

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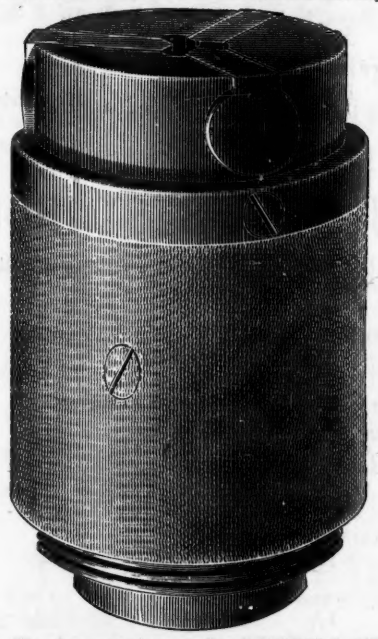

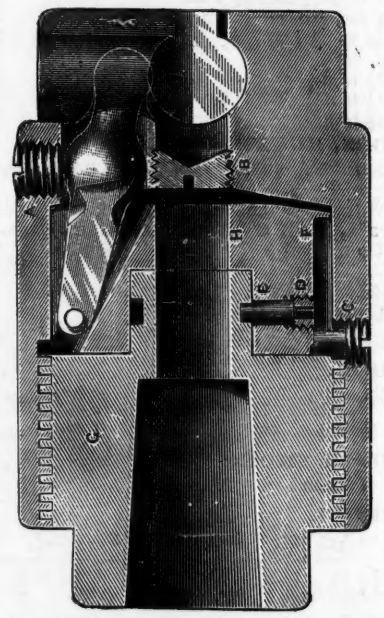

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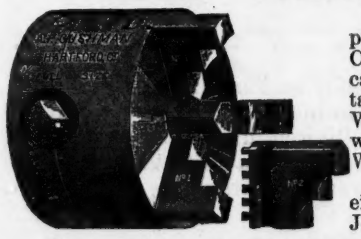

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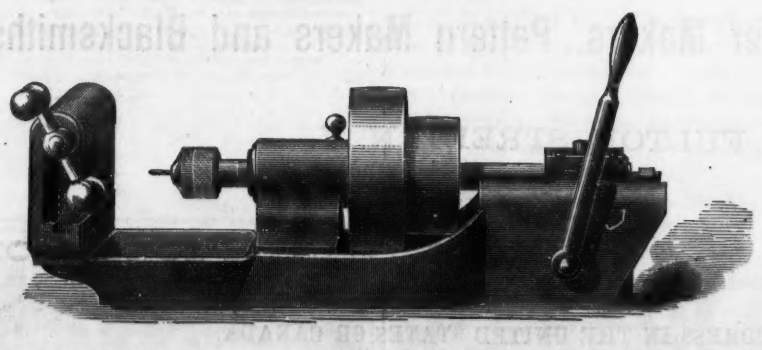

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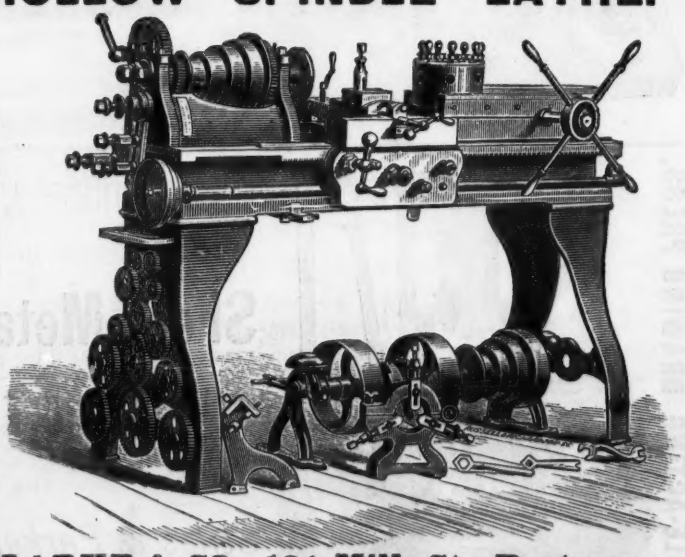

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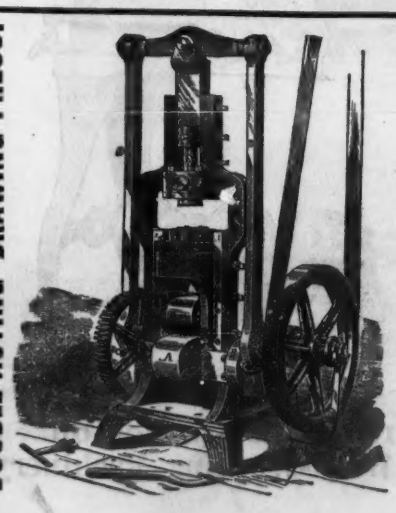

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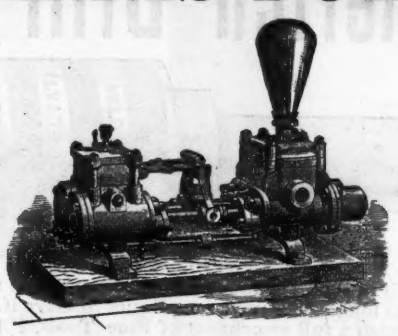

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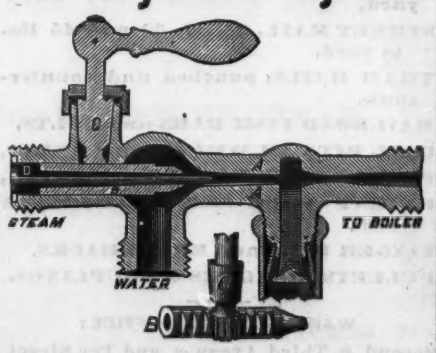

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